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Inter-Sectoral Governance of Inland Fisheries

E-book edited by
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Global Partnership for Small-Scale Fisheries Research

WorldFish

Andrew M. Song • Shannon D. Bower • Paul Onyango •
Steven J. Cooke • Ratana Chuenpagdee

Editors

Inter-Sectoral Governance of Inland Fisheries

Too Big To Ignore
In collaboration with WorldFish

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Too Big To Ignore (TBTI; toobigtoignore.net) is a global research network and knowledge mobilization partnership supported by 20 partner organizations and over 200 members from around the world. The network aims at elevating the profile of small-scale fisheries, arguing against their marginalization in national and international policies, and developing research and governance capacity to address global fisheries challenges.

Preface

This e-book is a product of the Inland Fisheries cluster of the Too Big To Ignore (TBTI): Global Partnership for Small-Scale Fisheries Research in collaboration with WorldFish. The editors and the contributors all share a similar passion towards promoting inland fisheries because despite the significant role of inland fisheries in supporting food security, livelihood enhancement and recreational pursuit of millions of fish-dependent people (both in the Global North and South), its importance is often missed in the wider sustainability discussion. Especially, given the multiple users of inland waterbodies whose activities very much rely on the same water ecosystems, inter-sectorality is an undeniable feature of inland fisheries functioning and management. This volume, which comprises 11 case studies plus an introductory synthesis, is aimed at giving readers a dedicated look into these diverse, complex, dynamic, scale-laden linkages that inland fisheries have with other water sectors. Several authors presented their work in an organized paper session at the 11th Asian Fisheries and Aquaculture Forum in Bangkok in 2016. Subsequent group discussions held at the TBTI Symposium in Kanchanaburi province, Thailand, also facilitated the compilation of this volume. The editors thank all the authors for their valuable contributions. We also extend our gratitude to Melinda Agapito, Philippa Cohen, Simon Funge-Smith, Vesna Kerezi and Prateep Nayak for their valuable institutional and intellectual support along the way.

Contents

CHAPTER 1

Inter-Sectoral Governance of Inland Fisheries: Research Needs and Foci

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Abstract One of the defining characteristics of inland fisheries is their connection to other essential human activities, such as hydroelectricity generation, irrigated agriculture, and transportation, which rely on the same fresh or brackish water ecosystems. Starting with the premise that an understanding of fisheries' interactions with these non-fishery sectors is in itself critical for achieving fisheries sustainability, this introductory chapter explores the topic of inter-sectoral governance and outlines an approach to examining the intricate and often challenging sector relationships. It first highlights the importance of inland small-scale fisheries, which are ubiquitous but often forgotten, and draws on 11 case study chapters around the world to propose four key areas of research that can structure the learning of the inter-sectoral dynamics – i.e., 'system description', 'valuation', 'power relations' and 'high-level discourse'. Analyses of these research foci will often need to be combined to advance more rigorous (and transdisciplinary) science and also inform appropriate courses for the governance of inland fisheries. Given the typically marginal position of fisheries in inland water-use discussions, the aim of this chapter, and the volume, is to lead a more integrated understanding of inter-sectoral interactions and promote further research with a view to raising the sector's profile in the wider society.

1. Introduction: Why Study Inland (Small-Scale) Fisheries?

Where do inland fisheries stand in the world of small-scale fisheries? Both in terms of policy and research, this is a question often not explicitly pursued and therefore somewhat neglected. Yet, inland fisheries have a prehistoric origin and still abound in many different

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contexts and locations – both in the Global South and North, and for commercial, subsistence and recreational purposes. The public ownership or common-pool nature of many dispersed inland waterbodies as well as low investment and relatively simple gear technology required in catching fish have also contributed to their common occurrence through time. According to the Food and Agriculture Organization, inland fisheries production has steadily increased in the last decade, contributing over 30 percent of the total fisheries catch in 2012 (FAO 2014). It has also been suggested that inland fish production could rival that of marine when all bodies of fresh water (e.g., small streams, ponds, lakes, and rivers which are currently not assessed) are accounted for globally (Welcomme 2011). Inland fisheries are crucial sources of animal protein and micronutrients, such as omega-3 fatty acids, calcium, vitamin A, iron and zinc, particularly in developing countries and Low Income Food Deficit countries; they thus play an important role in promoting global food security (Craviari et al. 2008; Youn et al. 2014). The sector is an important contributor to people's livelihoods. It provides harvest and post-harvest employment to approximately 61 million people around the world, of which 50% are women (Bartley et al. 2015). Inland fisheries are also capable of generating large economic values, as demonstrated in the Lower Mekong Basin, for instance, whose total value was estimated to be US$7 billion per year with an annual total fish production of about 3.9 million tonnes (MRC 2010).

Many issues beset inland fisheries, however, including overfishing, biodiversity loss, habitat degradation and proliferation of invasive species as well as socio-political impacts arising from access rights and large-scale hydroelectric development (Allan et al. 2005; Welcomme et al. 2010; Orr et al. 2012). Furthermore, since nearly 60 percent of the world's freshwater falls within a transboundary basin, in which at least one of the tributaries crosses a political boundary (Wolf et al. 1999), governance of inland fisheries has been a particularly arduous endeavour.

Despite the inland fisheries' significant contributions and challenges, they have so far failed to capture adequate public attention and generate political will deemed necessary to sustain effective conservation and management efforts (Cooke et al. 2013, 2016). The exclusion of inland fisheries in preference to a sole focus on the marine domain in the 2030 Sustainable Development Goals is a stark reminder that inland fisheries occupy a peripheral position in the wider sustainability discussion. Are inland fisheries being forgotten even though they are also too big to ignore? What could focused research on inland small-scale fisheries tell us more about natural resource governance?

2. Broad Research Agenda

The Global Conference on Inland Fisheries (http://inlandfisheries.org/) held at the FAO headquarters in Rome in January 2015 was a landmark event that gave undiluted attention to inland fisheries from multiple angles. Through active participation of delegates from around the world, it aimed to deliberate a concerted statement on urgent research agenda and on-the-ground implementation needs. It also focused on raising political action required to

better incorporate the concerns of inland fisheries into policy. The conference resulted in several key messages, including:

1) Improving biological and production data assessment: Obtaining accurate and complete information about inland fisheries production is a difficult process because most inland fisheries activities are small-scale, highly scattered, wherein the harvest is for subsistence, or traded or consumed locally and generally unreported to governmental agencies. Similarly, considerable numbers of fish caught by recreational fishing are consumed but remain unreported. This points to a need to put efforts in developing standardized methods of biological assessment of inland fish populations and harvest, which would include data collection, database management, data sharing and reporting at the appropriate local, national and global scales.
2) Adequate valuing of economic, social and cultural dimensions: There has often been a lack of recognition of the cultural values, beliefs, knowledge, social organization and diverse livelihood practices of inland fishers, fish workers and their communities including indigenous people. This has often resulted in policies that exclude these groups and increase the vulnerability of fishing communities. Such exclusion deprived them of culturally and economically important connections and access to aquatic ecosystems and the services they deliver. A comprehensive "valuation" of inland fisheries' economic, nutritional, and cultural contributions to ecosystem health and human societal wellbeing is required to avoid underestimation of the true economic and social value of well-governed inland fisheries.
3) Negotiating external threats and seeking cross-sectoral integration: The production of inland fisheries is dependent upon the quantity and quality of freshwater and freshwater aquatic habitats and is predominantly influenced by factors external to the fisheries. Many of the competing uses of freshwater resources, such as agriculture, domestic use and power generation, and the lack of cross-sectoral integration among them are negatively impacting them. With the human population expected to exceed 9 billion by 2050, increasing demands for freshwater will further impact the productivity of inland waters. There is an urgent need to promote cross-sectoral fora to facilitate discussions about the trade-offs and synergies of inland freshwater development options that consider the fishery sector as an equitable partner in resource management.
4) Achieving transboundary and inter-jurisdictional coordination: Many international and transboundary inland water bodies do not have a governance structure that holistically governs the use and development of fishery resources. This often results in decisions being made in one location that adversely impact resources, food security, and livelihoods in another area. Establishing joint governance institutions, e.g., river or lake basin authorities, or expanding the mandate and capacity of existing institutions to address or incorporate inland fisheries in the multilateral decision making processes need to be considered. This is also to be accompanied by governments committing to implement internationally-agreed decisions through their national policies.

This volume engages with the theme 'negotiating external threats and seeking cross-sectoral integration', or inter-sectoral governance. It finds support in the outcome document called

"The Rome Declaration: Ten Steps to Responsible Inland Fisheries" (FAO and MSU 2016), which specifies the need to "Develop collaborative approaches to cross-sectoral integration in development agendas" as one of the steps. Comparatively speaking, however, inter-sectoral linkages have generally lacked dedicated research attention (for exceptions, see Arlinghaus 2005; Ratner et al. 2013; Lynch et al. 2016; Nguyen et al. 2016). There remain few systematic investigations that synthesize the details of fisheries' external conflicts, whose formation and impact are often poorly understood (Bennett et al. 2001). It, thus, forms a significant knowledge gap in the literature about the governance and utilization of fresh and brackish water fisheries resources.

3. Governing Inter-Sectoral Interactions

Arguably, the greatest risks to the governability of inland fisheries originate from outside the fishery sector (FAO 1997; Cowx 2002; Cowx et al. 2010; Beard et al. 2011). Important societal needs such as drinking water, irrigation for agriculture, power generation, navigation, and effluent disposal all rely on the waterbodies and aquatic resources in which inland fisheries are also based. Associated impacts, including habitat degradation, water pollution, and flow modification, serve as major constraints to the steering of inland fisheries, and to a greater degree, to the protection of aquatic biodiversity (Cowx 2002). 'Besieged' by these external pressures, inland fish are considered one of the most endangered groups of species in the world (Jenkins 2003; Dudgeon et al. 2006) and freshwater habitats among the most altered and threatened ecosystems (Brönmark and Hansson 2002; Malmqvist and Rundle 2002) with many experiencing a critical transition or a regime shift (Nayak et al. 2016).

Hence, there is an acute need to learn from the experiences of inland water systems around the world (e.g., lakes, rivers, wetlands, brackish lagoons) and bring forward a synthesis that discusses the conflicts and synergies between diverse sectors as well as organizes ways in which inter-sectoral influences can be studied. This volume offers the contribution of 11 case studies which engage with one or more of the following questions:

- Which external (internal) sectors do inland fisheries interact with?
- How do these relationships play out in each locale?
- Are there conflicting or cooperative interplays between different fishing interests or groups?
- What are the broad discursive mechanisms by which inter-sectoral influences are borne and inland fisheries impacted?

4. Case Studies

The case studies originate from three broad regions of the world – Europe (2 chapters), Africa (3) and South/Southeast Asia (6). They also comprise a wide range of inland water settings with 4 cases illustrating lake fisheries, 3 focusing on the river environment, 2 set in

deltaic/lagoon-based brackish waters and 2 describing wetland/flood plain fisheries. The time period featured in the cases span from historical to contemporary (see Table 1.1 for summary). While the chapters mostly rely on social sciences disciplines such as natural resources studies and environmental history, ecological data was also utilized in some cases to enrich the explanation of changing or reinforcing inter-sectoral relationships. Collectively, these 11 chapters represent a reasonably diverse array of relevant cases from which integrative insights about inter-sectoral dynamics and governance can be drawn.

5. Synthesis

Thematically, the cases generated a synthesized understanding of inter-sectoral interactions. This can be phrased as four research foci that are inter-related – 'system description', 'valuation', 'power relations' and 'high-level discourse'. 'System description' is likely the starting point of any inquiry, through which the resource environment, involved sectors and the history of interactions including any overt crises are identified. The other areas denote three broad discursive mechanisms by which inter-sectoral influences are borne and inland fisheries impacted. Valuing is an attempt to establish the relative worth of different sectors. It is sought to guide decision-making around water uses. There may also be ingrained or changing power differentials between sectors that manifest in the form of unequal resource access rights, lobbying power, or the strength of sector organization and economic capacity, which shape the water-food-energy nexus discussions. Finally, global or regional policy directives or prevailing political economy can create a far-reaching effect in local-level water decisions by framing resource problems, prioritizing certain sectoral needs and thus encouraging specific development strategies that may not be compatible with inland fisheries. Each of these key areas of understanding is explained in more detail below.

5.1. System description

The 'system description' research seeks a basic understanding of the governance history and the present regulatory setup (e.g., the legal mandate, the remit of different sectors and the diverse management objectives) as well as the prevailing social-ecological conditions and cultural characteristics that reside over the waterbody. It calls for a candid depiction of what can be observed in the interactions occurring at different scales and multiple fora, concentrating on what is visible, overt and therefore comparatively easy to assess and record. A vast range of possibilities exists for what should be described depending on the empirical reality of each locale. Principal questions would include which sectors are present at a waterbody and to what extent, and where each sector is positioned in the institutional structures that pertain to the governance of the aquatic system. Accounts of any contact or confrontations as well as synergistic solutions (i.e., "win-win" scenarios, see Beard et al. 2011; Lynch et al. 2016) would also form a pertinent knowledge. Forming a 'background container', this research strategy has been widely employed, and can foreground a description of more profound issues.

Table 1.1. Case studies at-a-glance (in the order of presentation in the volume).

Contributors	Environment	Sectors involved	Key narrative(s)	Time period covered	Featured discipline(s)
Islam, Shamsuzzaman, Sunny and Islam	Meghna and Padma Rivers (Bangladesh)	Mechanized and non-mechanized boat fishing groups, fish traders/ middlemen and NGOs, various government bureaus instituting or supporting a fishing ban	Examines the causes of conflicts and social tensions among various groups surrounding hilsa sanctuaries as they relate to increased competition over fishing space and irregularities in distribution of economic incentives	Present	Natural resources studies
Baer, Eckmann, Rösch, Arlinghaus and Brinker	Upper Lake Constance (Germany-Switzerland-Austria)	Commercial capture fishery; aquaculture; tourism; drinking water; nature conservation	Constructs a history of nutrient dynamics and lake water quality driven by factors external to fishery, and describes the varied impacts this has created on lake ecology and on different water-based sectors including capture fishery	Early 20th century to present	Lake and fish ecology
Nunan and Onyango	Lake Victoria (Tanzania-Kenya-Uganda)	Three main commercial fisheries – Nile perch, Nile tilapia and dagaa; agriculture; forestry	Outlines the history of fisheries governance, and discusses inter-sectoral conflicts and cooperation by taking into account the multi-level and trans-boundary setup of the lake	Late 20th century to present	Natural resources studies
Hettiarachchi and Morrison	Urban wetlands in Kolkata and Colombo (India and Sri Lanka)	Waste water-fed pond pisciculture; capture fisheries; agriculture (rain-fed rice cultivation); real-estate development; urban use of water	Compares the governance and fisheries/ecological outcomes in two urban wetlands in South Asia and analyses the factors that led to different trajectories	Colonial (late 19th and early 20th centuries) to post-colonial to present	Wetland ecology; environmental history; institutional analysis
Mhlanga and Nyikahadzoi	Lake Kariba (Zambia-Zimbabwe)	Inshore gillnet fishery; offshore kapenta fishery; cage aquaculture; recreational fishery; tourism and hospitality; wildlife management; hydropower generation	Discusses various intra-sectoral and inter-sectoral conflicts observed in Lake Kariba, and governance arrangements for the fisheries at national and bi-national levels	Late 20th century to present	Natural resources studies
Salmi and Sipponen	Finnish lakes (Finland)	Commercial fishery; recreational fishery; wildlife conservation	Describes how commercial fishery gets marginalized vis-à-vis recreational fishery and seal conservation, and discusses the importance of	Late 20th century to present	Natural resources studies

			local food movement and new governance arrangements for altering the power relations		
Bower, Raghavan, Mahesh, Danylchuk and Cooke	Cauvery River (India)	Subsistence fishery, recreational fishery, hydropower generation, sand mining	Introduces the fishery, management measures and governance structures, and describes conflicts between recreational and subsistence fisheries and other inter-sectoral issues	Present	Natural resources studies; fish ecology
Tezzo, Kura, Baran and Zi Za Wah	Ayeyarwady Delta (Myanmar)	Open-access fishery; leasable fishery (privately leased); rice cultivation	Describes the origin, evolution, limitations, prospects and estimated values of 'leasable' fisheries, and suggests research recommendations	Colonial (19th and 20th century) to present	Natural resources studies; institutional analysis
Singh and Gupta	The mid-Ganga basin in the Ganga River (India)	Capture fishery; colonial interests in revenue extraction and fish conservation	Describes the 'diara' ecology, and explains how the British colonial government established state control over waterbodies which led to privatization and loss of water access for river-dependent fishing communities	Colonial (18th and 19th century)	Environmental history
Akintola and Fakoya	Badagry Creek (Nigeria)	Capture fishery; water transportation; sand mining; eco-tourism	Provides a succinct yet comprehensive account of the fishery, social context and governance arrangements as well as inter-sectoral relationships with other lagoon-based activities	Pre-colonial to present	Natural resources studies; cultural history
Gurung and Sah	Koshi Tappu flood plains in Saptakoshi River (Nepal)	Capture fishery; wildlife conservation park; tourism; sport fishing	Describes fishery characteristics and conflicts between fishing and wildlife conservation, and proposes community-involved fishing tourism as a win-win solution	Present	Natural resources studies

Mhlanga and Nyikahadzoi (this volume) draw attention to spatial and historical struggles among different sectors that operate in Lake Kariba, among which are competition for overlapping littoral space between fishery and tourism industries (such as houseboats and lodges) and controversies surrounding big game poaching between fishers and the wildlife conservation authority. In these situations, both physical and perceived confrontations are possible, as poachers make an illicit entry into conservation areas through fishing camps and also fishing can intrude into a holiday-makers' pristine wilderness experience. The authors also report a case of post-colonial racial tension between the white-operated ring net-based *kapenta* (*Limnothrissa miodon*) fleets and black gillnet operators.

Nunan and Onyango (this volume) have highlighted the multi-scalar setup of inter-sectoral linkages in Lake Victoria. On the one hand, there are community-level interactions that occur between village committees or occupational groups that are largely based on personal relationships and informal encounters. On the other hand, supra-national cooperation is being encouraged through the Lake Victoria Basin Commission, which is tasked with the harmonization of policies and laws within the East African Community member countries for improving the collaborative management of transboundary natural resources, pollution and environmental degradation in the basin. Authors argue that coordination at the national level appears key, as both the effectiveness of decentralization and of upward ministerial involvement hinge on the sound oversight and financial capacity of the central government.

Islam et al. (this volume) write about *intra*-sectoral interactions and the *inter*-sectoral kind that take place among different fishery interests in Bangladesh. The authors catalogued cooperative and conflicting relationships that often simultaneously appear between various fishery-related actor groups, such as fishers, fish entrepreneurs, micro-finance non-governmental organizations, law enforcing agencies and the local government in charge of administering the Payment for Ecosystem Services scheme.

The inter- and intra-sectoral relationships most commonly observed in inland fisheries are summarized in Table 1.2. While the explicit focus of this volume is on *inter*-sectoral, there are also *intra*-sectoral interactions that can be instructive, as demonstrated by several chapters in the volume. Despite fish being the common denominator of all fishery-related sectors, various groups might still hold opposing interests and construct different meanings for the fisheries and the waterbodies, creating governance implications that are not entirely dissimilar to the inter-sectoral interactions.

5.2. Valuation

The 'valuation' research is about assessing 'assigned' values of different sectors. Using a wide range of valuation techniques, comparison of assessed values permits estimating how different sectors measure up in terms of the contributions they pose to the society, and

subsequently adjudicating any inter-sectoral trade-offs. Proper valuation is expected to bring more informed decision-making in favour of inland fisheries and garner greater public support within the context of wider economic development and sustainable livelihoods. With an implicit assumption of a zero-sum game, this approach ultimately seeks an instrumental explanation and has been given considerable attention in inland water resource research (e.g., Baran et al. 2007; Ziv et al. 2012).

Table 1.2. List of 'within-fishery' sectors that are part of an inland fishery system, and 'beyond-fishery' sectors that interact with inland fisheries. (Note: these are representative labels thus not necessarily mutually exclusive – e.g., there can be a subsistence component to all other fisheries sectors; water quality overlaps with the concerns of multiple sectors, including fishing, domestic use, tourism and nature conservation).

Inter-sectoral (beyond fishery)	
- Hydropower generation	- Flood control and drainage
- Potable water and domestic use	- Industrial use including mining
- Agriculture, silviculture and irrigation	- Recreation and tourism
- Nature conservation and animal rights	- Shipping and transportation
Intra-sectoral (within fishery)	
- Commercial fishery	- Recreational fishery
- Subsistence and indigenous fishery	- Migrant fishery
- Poaching/illegal fishery	- Aquaculture
- Fish trading and processing	- Marine fishery

Among the approaches developed to capture different kinds of values (e.g., socio-cultural and ecological values), economic valuation has been the one most commonly pursued. An enhanced understanding of the monetary value may reveal the fishery sector's *true* economic significance, which in many cases, have been simply buried and therefore ignored. Situating the valuation of fish and fisheries in the broader rubric of ecosystem services has also been touted as an effective strategy that highlights their essential connections to ecosystem functioning (e.g., Hoeinghaus et al. 2009).

> Tezzo et al. (this volume) report the annual price of 'leasable fishery' in the Ayeyarwady region of Myanmar based on direct survey work. In 2014, the average price of the lease was estimated to be US$ 5,726 with a large majority of the 1,265 leases recorded in the region valued above US$ 1,000. Given that US$ 1,105 is the average annual per capita income in Myanmar (World Bank 2014), these figures highlight the considerable value of fishery in the local context and its relevance as a prized asset.

In addition to economic values, there are other kinds of values, which can be understood to more fully characterize inland fisheries. In fact, the greatest offering of many inland fisheries to society is perhaps found in their non-economic contributions expressed through values that are non-monetary and even not easily quantifiable (i.e., for an analogous debate, see wealth-based vs. welfare-based functions of fishery, Cunningham et al. 2009; Béné et al. 2010; Nunan 2014). For instance, accurately capturing the scope of food security and nutritional benefits bestowed by inland fish and fisheries and the extent to which they

contribute to people's livelihoods can be an important marker of their importance. Furthermore, inland fisheries are often a source and a carrier of experiential, identity, cultural and place attachment values for those who participate, providing psychological, spiritual and communal benefits (e.g., Close et al. 2002; Jackson et al. 2005). These humanistic values that go beyond the instrumental purview can help set apart inland fisheries from other water-utilizing sectors, helping to advance different, and more diverse, arguments towards elevating the public perception and the political impetus for inland fisheries.

Aside from more conventional quantification techniques that include cost-benefit analysis, contingent valuation method, Economic Impact Assessment methods such as using the gross value of fish landings based on market prices (e.g., Neiland and Béné 2006) and various modelling approaches (e.g., Orr et al. 2012), there has also been an increasing interest in utilizing fish consumption data based on agricultural household surveys (e.g., Belton et al. 2011), non-monetary ranking techniques such as damage schedules (e.g., Song and Chuenpagdee 2013), socio-economic or livelihood analysis (e.g., Béné and Neiland 2003) and even narrative approaches that centre on individual, community and societal wellbeing (e.g., Song 2017). Despite the significant challenges noted above, there appears a widespread optimism that valuation is a research frontier that holds the prospect for a great breakthrough in clarifying and enhancing the inter-sectoral position of inland fisheries (Cowx and Portocarrero Aya 2011; Cooke et al. 2013; Lynch et al. 2017).

5.3. Power relations

This area of research privileges the role of power in addressing the inter-sectoral governance of an aquatic system. Involving multiple sectors with diverse interests and overlapping administrative boundaries means that there can arise uneven power relations that undergird a particular dynamic between water sectors, including the marginalization of inland fisheries.

The trend of inland fisheries research reflects the broader domain of fisheries and water resource research, in which power remains an understudied topic (Weitz et al. 2017). Even in studies that address power, prioritization of its specific facets, such as conflict, inequity and marginalization, are often needed for researchability (e.g., Bennett et al. 2001; Nguyen-Khoa and Smith 2004; Arlinghaus 2005). Nevertheless, this is widely-acknowledged as a crucial topic of investigation, with World Bank (2004), for instance, asserting that "it is necessary to recognize the reality of existing power and influence if effective fisheries and coastal management is to be achieved."

Asymmetrical power relations do not, however, always result in conflict and social disorder (Lukes 1974; Gaventa 1980). A seemingly peaceful and consensual situation may in fact be harbouring entrenched inequality, domination and deprivation in which the sense of powerlessness within fisher groups is prevalent and self-perpetuating. This reinforces the fact that an investigation of power is all the more crucial in a multi-stakeholder, inter-sectoral setting, in which large power differentials may be operating. In many inland fisheries, both in developed and developing regions, such covert power dynamics might be what is happening. Dedicated approaches drawing on political ecology or political economy (e.g., see Derman and Ferguson 1995; Sneddon 2007; Béné et al. 2009; Nayak et al. 2016; Sneddon and Fox

2012) will certainly be helpful. Yet, more general approaches utilizing qualitative methods such as field-based ethnographic research and discourse analysis of policy documents would also represent a useful contribution.

Salmi and Sipponen (this volume) have analysed the complex power relations that have occurred in vendace fisheries (*Coregonus albula*) in Finnish lakes. In the early 1990s, water owners of private lakes had used their legally-sanctioned management authority to refuse the granting of commercial fishing permits despite scientific reports suggesting that commercial fishery using small pair trawling and seine netting does not jeopardize the stock health. The authors write that local water owners' opposition to commercial fishing is tied to their will to stamp positional clout in local-level fisheries management and at the same time advance their recreational fishing opportunities. More recently, an increasing concern of nature conservationists for the bycatch of endangered Saimaa ringed seal (*Pusa hispida saimensis*) had successfully convinced water owners and government authorities to institute a system of seasonal fishing bans. While the fishing ban applied equally to the both commercial and recreational fishing groups, a heavier impact was on the approximately 60 commercial fishers located in the habitat of the Saimaa ringed seal who became deprived of an important income source, compared to about 400,000 recreational fishers in the area. According to the authors, the lack of consideration of the livelihood aspect for commercial fishers is another reflection of the weaker lobbying power and political standing of the commercial lake fishery in relation to the recreational sector. It also hints at the lower priority of natural resource utilization vis-à-vis nature conservation in decisions being made about waterbody use.

5.4. High-level discourse

This area of research seeks to examine high-level societal aspirations and discourses that exert influence on inland fisheries. Also phrased as 'global drivers' (Nayak and Berkes 2014; Lynch et al. 2016) or 'external inputs' (Nguyen et al. 2016), these are seen as external forces that go beyond the geographical confines of a defined waterbody (or a watershed), thus escaping the immediate control of local or national actors, and can strongly motivate objectives and priorities for development and management of inland waters (Lynch et al. 2016). Such multi-scalar dynamics are an increasingly important consideration in the current era characterized with economic globalization, supranational coordination and climate change. Concepts such as 'cross-scale linkages' (Berkes 2002) and 'telecoupling' (Liu et al. 2013) all elaborate on general theories of ways to ensure environmental and natural resource sustainability in light of these "distant" implications.

Inland fisheries are no exception to such expanding governance purview. Ideas, resources, finances, people and goods can all descend upon the sites of fisheries affecting the trajectory of inter-sectoral interactions. Synergistic and balanced relations that may had existed between fisheries and other sectors may start to tip in favour of a new dynamic fed by a development of a particular discursive undercurrent. The aspiration towards turning rivers into a source of hydropower generation is a well-reported case in point (Bakker 1999;

Winemiller et al. 2012). In the Mekong River basin, large-scale hydropower development powered by big dams is a dominant and long-running regional theme that has garnered the strongest political and financial clout (Gleacen and Palettu 2007). With Laos aspiring to be the hydroelectric "battery of Asia", for example, the social and ecological impacts the continuing hydro-development brings to fisheries and fishery-based livelihoods is real and looming (Baran and Myschowoda 2009; Vaidyanathan 2011). Understanding inter-sectoral interactions would therefore require a broadening of a research scope to see these multi-scalar connections as integral to the process of governing inland fisheries.

Hettiarachchi and Morrison (this volume) present a case of an urban wetland fishery in Kolkata, in which the fishery sector is put under growing pressure from a wider development agenda which has upset local-level symbiosis. In the early 20th century, in response to wastewater and sewage discharge from an expanding city, the dwellers of the East Kolkata Wetlands skillfully devised a vast network of freshwater ponds to transform pollutants into a source of nutrients for aquaculture. This had marked a symbiotic relationship between urban water treatment needs and wetland livelihoods, which was exemplified by the annual production of 8,000 t of fish in exchange for a daily intake of 0.7-1.0 million m^3 of wastewater in 2010. However, spurred by the pro-capital economic restructuring in India during the 1980s, the wetland system came under intense urbanization pressure. Speculative real-estate investment and the inflow of international finance capital ensued, and as a result, nearly 20% of the wetland area was reclaimed for real-estate purposes by 2003 with more unaccounted conversion suspected in recent decades.

Baer et al. (this volume) describe how a European Union-led agreement on improving water quality can influence the image of a lake such that water quality quickly establishes itself as the primary concern for the management of a waterbody. The societal narrative towards "clean" water can work to benefit those sectors that favour an oligotrophic condition with clear-blue water while overshadowing others that prefer a more mesotrophic state such as a commercial capture fishery. The authors write that the commercial fishery sector now find themselves second in terms of socio-political importance compared to environmental protection, tourism, water quality and outdoor recreation, and it no longer play a central role in lake management and decision-making.

6. Conclusion

Production of inland fisheries is dependent upon the quantity and quality of freshwater and aquatic habitats and is predominantly influenced by factors external to the fisheries. Many of the competing uses of freshwater resources, including agriculture, domestic use and hydroelectricity generation, and the lack of cross-sectoral integration among them are impacting the fisheries in multiple ways. The current volume focuses on this research agenda to present four thematic areas from which an understanding of inter-sectoral dynamics can

be derived with more rigor. 11 case study contributions are leading the way. More input is further requested, from other areas of the world as well as from diverse disciplinary angles. Viewing research outcomes and policy initiatives of inland fisheries through inter-sectoral lenses can help stimulate more fruitful research towards streamlined water development and contribute to a balanced governance of diverse industries and interests. We submit that failure to act upon this need risks further dissipation of the livelihood and biodiversity functions of inland waterbodies, putting millions of small-scale fishers and waterside communities' crucial dependence worldwide in jeopardy.

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CHAPTER 2

Understanding Fishery Conflicts in the Hilsa Sanctuaries of Bangladesh

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Abstract This chapter examines the causes of conflict and social tensions in the hilsa sanctuaries of Bangladesh. To collect the empirical data, a survey was conducted in two fishing communities situated adjacent to hilsa sanctuaries, which was further informed by semi-structured interviews with other fishery stakeholders in the region. The analysis shows that conflicts in the hilsa fishery are related to a number of factors such as increased competition over fishing space and irregularities in distribution of economic incentives. Conflicts in the fishery negatively affect the well-being of hilsa fishers and lead to increased social tension in the communities. Thus, a challenge for policy makers is to find a solution that benefits both the fishery conservation and poverty reduction. Based on the findings, the present study submits that a balance of fishery conservation and poverty reduction could be achieved by augmenting co-operative relationship that exists among different stakeholders in the hilsa fishery and in that case, co-management could be an effective tool.

1. Introduction

Fishery is a complex and dynamic bio-socio-economic system with many interactions amongst the resource itself, humans and governing institutions- where evidences of conflict are voluminous (Charles 1992; Bavinck 2005). Fishery conflict may arises when 'the interests of two or more parties clash and at least one of the parties seeks to assert its interests at the expense of another party's interests' (FAO 1998, p. 199). Different authors summarized the major causes of fishery conflicts, such as competition over scarce fish resources, demographic changes, dispute over use of fishing space, division of fishery benefits with different stakeholders in a fish chain, inequitable power relations, structural injustices and institutional failures, changing government priorities and rules that govern the fishery. In

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some cases, external competing users - such as aquaculture and tourism that vie for access to aquatic space and fish habitats also spark social tension (Charles 1992; Warmer 2000; Bennett et al., 2001). Understanding fishery conflict is important since such dispute may produce hardships and reduce the well-being of fishery users (Bennett et al. 2001).

In recent years, a number of studies have identified a wide array of causes that might escalate conflicts over fisheries resources in a tropical context (Charles 1992; Warner 2000; Bennett et al. 2001; Bavinck 2005; Jahan et al. 2009, 2014). Charles (1992) organized the wide range of fishery conflicts into four inter-related categories, such as (i) Fishery jurisdiction (related to property rights, government role and intergovernmental conflicts), (ii) Management mechanisms (related to the management issues), (iii) Internal allocation (related to conflicts arising within the specific fishery system) and (iv) External allocation (related conflicts emerging between internal fishery players and outsiders). Later, Warner (2000) included exogenous effects such as secondary stakeholder as another category in fisheries conflict typology. Bennett et al. (2001) revised Charles (1992) and Warner (2000) categories and introduced another typology of five categories covering conflict between fishers and multiple other actors outside the fishery.

In Bangladesh, which is ranked fourth for inland fisheries production in the world, fishing is the second largest agrarian economic activity. Bangladesh as a country heavily relies on fishery for a source of protein, livelihoods and income. For instance, fisheries supply an estimated 60% of the total animal protein demand. Covering an estimated total of 3 916 828 ha, the inland capture fishery produced 961 458 mt fish in 2012-2013 that represented 28.19% of total fisheries production of the country (FRSS 2014). In recent decades, both inland and coastal fisheries have faced several challenges such as overfishing, severe resource degradation, overcapacity, and climate change and variability, to mention a few (Islam, 2012). These factors coupled with institutional ineffectiveness, the influx of new entrant fishers, control over fisheries resources and space, extensive use of destructive fishing practices have led to increased incidence of conflicts among fishery stakeholders in inland fisheries of Bangladesh (Jahan et al. 2009, 2014; Islam 2012).

Among all fishery species, hilsa shad (*Tenualosa ilisha*) constitutes the single most important fishery of Bangladesh (Photo 2.1) valuing BDT. 90 billion (approx. USD 1.3 billion) annually (BOBLME 2012). Nearly 11% of the country's total fish production is contributed by the hilsa fishery (DoF 2015). It is estimated that more than half a million people depend on it for their livelihoods (Mohammed and Wahab 2013). The hilsa fishery is also identified as the largest estuarine fishery in the world in terms of catch (Blaber 2000) and constitutes a long-standing economic activity in the Meghna River basin. Fishers usually use drift gill nets (locally known as *gulti jal, kona jal*), monofilament gill net (*current jal*) and seine net (*ber jal*) to catch hilsa, of which later two types net are illegal.

There are a number of groups and categories of people involved in the hilsa fishery. Thousands of people are involved in hilsa fishing and in different forward and backward linkage activities in the fish chain. The fishery is capital intensive, so the majority of the fishers cannot afford to go fishing at own cost, thus having to depend on middleman (*aratdar* and *mohajan*) for economic support. Usually *mohajan* take advanced loan (*dadon*) from fish traders *(aratdar*) for buying or maintenance of productive assets for hilsa fishing and sale

their catch to *aratdar* at lower than market price and also pay percentage commission of total price. *Mohajan* either work as the head (*majhi*) of the fishing team or hire another experienced crew as *majhi* for his business. Crews are termed *malla* or *vaghi*, and are either waged labour or sharer of fishing profit (Photo 2.2). Among all, *aratdar* as investor is a key player in the capital intensive hilsa fishery.

Photo 2.1. Hilsa shad (*Tenuolosa ilisha*) constitutes the single largest fishery in Bangladesh.

Photo 2.2. In a mechanized boat fishing team consists of *majhi* and several fishing crews.

To protect the fishery from recruitment and growth overfishing, the Government of Bangladesh (GoB) has declared five sanctuaries in the Meghna River and other associated rivers (Figure 2.1). Department of Fisheries (DoF) in cooperation with law enforcement agencies and local government administration initiated a countrywide ban for eight months from November to June every year on fishing of catching, carrying and sale of *jatka* (juvenile

hilsa less than 25 cm in size). Another restriction is placed on the catching of brood (mature and about to spawn) hilsa for 22 days during the peak breeding season in October, before and after the full moon. To compensate for loss of earnings due to fishing restrictions, the government initiated a Payment for Ecosystem Services (PES) program for fisher communities (187 000 households) with 40 kilograms of rice per household per month and supporting alternative income-generating activities (Rahman et al. 2012).

After establishment of the sanctuaries the production of hilsa increased both in inland and marine waters. However, the majority of the dependent fishers have suffered economic hardship as the compensation is deemed to be insufficient. Such competing interests of conservation efforts and livelihood necessities caused spike in tension. Competition with fishers' groups and tension with other institutional authorities are arising significantly. This conflict included social, economic and econometric aspects, technological aspects and anthropological aspects (Jabri 1996). As stated above, conflict may produce hardships for the poorest members and may reduce overall well-being of other members of the society. If the institution is no longer able to effectively minimize conflicts and facilitate cooperation, community structures may be weakened and will be increasingly unable to function properly. Therefore, it is necessary to find out the underlying conflicting issues and possible policy recommendation for a win-win solution for poverty reduction and fishery conservation.

Using the hilsa fishery in two sanctuaries in Bangladesh, the chapter explores fishery conflicts in the inland sanctuaries context. In order to provide a better understanding of the conflicts this study will (i) examine the factors that cause fishery conflict and social tension, (ii) investigate the trade-offs involved between different fishery stakeholders and, (iii) offer solutions or processes that benefit both poverty reduction and environmental conservation (i.e., 'win-win' scenarios).

The remainder of the chapter is organized as follows. Section two provides a brief description of the methodologies used for studying fishery conflicts in Meghna River system. Section three presents results and discussions whilst the section four concludes with some policy recommendations.

2. Materials and Methods

The study was informed by both primary and secondary data. To collect empirical data, fieldwork was conducted during January 2015 in two fishing communities named Banglabazar of Shariatpur district and Puraton Hijla of Barisal district; both villages are situated adjacent to two hilsa sanctuaries in the rivers of Padma and Meghna (Figure 2.1). The selected communities are mainly dependent on hilsa sanctuaries to earn their livelihoods by various fisheries activities such as fishing and fish trade. Thirty in-depth interviews were conducted using semi-structured questionnaire. The questionnaire asked information regarding perceived cause and the nature of the conflicts as well as participants involved in the conflicts. In addition, twenty key informant interviews were conducted with knowledgeable persons that included *majhi,* fisheries official, and fish trader (*aratdar*). Two focus group discussions were conducted in the two villages. Collected data were entered into a database

system, then contents were analysed and themes were identified and classified into variables.

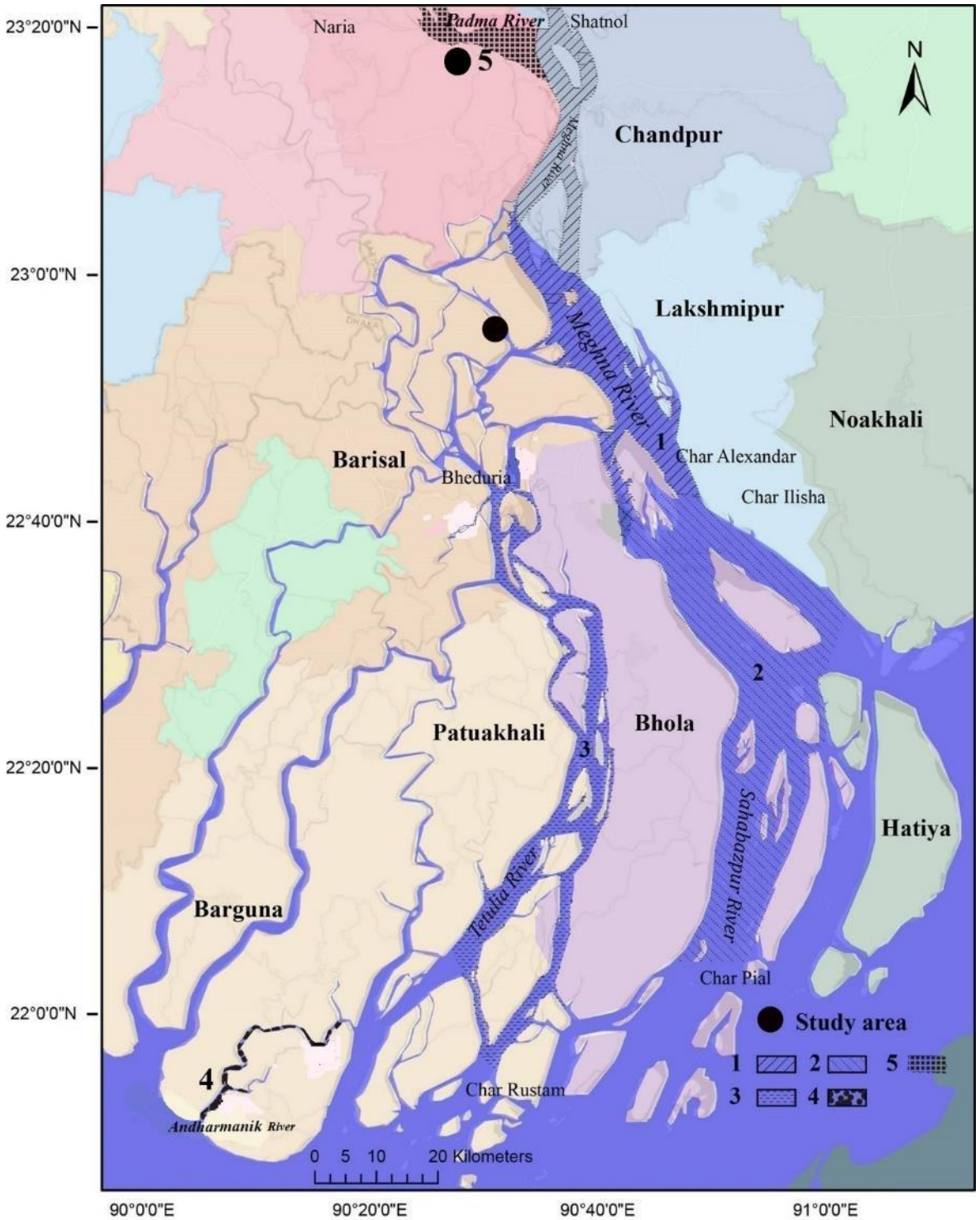

Figure 2.1. The location of study areas and five hilsa sanctuaries in the Meghna River, and other associated rivers and inshore waters. (Two dark circles show the study areas. Five different shades in rivers represent the extent of five hilsa sanctuaries).

3. Results and Discussion

3.1. Conflict among fishers

Increased number of fishers is a common concern by most of the interviewed fishers. In addition to an overarching pressure from population growth, each year many farming households become destitute due to river bank erosion and cyclone. A portion of them thus start their livelihood from scratch by entering into fishery. Since hilsa is a profitable fishery, *aratdar* encourages entry of new fishers into the fishery which leads to overcapitalization. The over-crowded situation in the fishery is explained by a 40-year-old fisher as: *During my teenage years, I could hardly see any other fisher in a mile distance. Now nets are set so close like fingers on hand* (Interview conducted in Puraton Hizla).

Thus there are intense competitions for fishing space which often lead to conflicts that cause loss of property or even physical harm (Table 2.1), which often spills over into communities on land further increasing social tensions. Most notably, there are conflicting situations among mechanized and non-mechanized fishers. Fishers of non-mechanized boat and mechanized boat blame each other for illegal fishing, though both types of fishermen continue fishing during the ban period. But due to limited mobility with smaller boat (Photo 2.3), non-mechanized fishers can only harvest a smaller catch and often caught red handed during raid by law enforcers. However, mechanized fishers can harvest more due to greater mobility and can escape easily due to higher speed of boat engine. One fisher explains the situation as: *Large mechanized boats are usually owned by local people with connection to power. They usually give bribes to the police and are able to continue fishing during the night. If there is any raid, they usually get information from their sources in a police station. Non-mechanized engage in illegal fishing out of dire need of survival but mechanized fishers do fishing out of greed* (Interview conducted in Banglabazar).

Photo 2.3. Fishers of non-mechanized boats face competition for fishing space.

Competition for inclusion in the compensation scheme of the GoB, together with irregularities in rent distribution sometime also cause spike in tension. However, majority of interviewed fishers agreed that supports from their colleagues are important to overcome any crisis situation such as sudden illness (Table 2.1). Again, in the sanctuaries, non-hilsa targeting fishers are not eligible to receive any compensation. However, they also face restrictions as law enforcers sometimes fail to differentiate between fishers, prohibiting all netting in the sanctuaries during the hilsa ban season (Photo 2.4).

Photo 2.4. Non-hilsa fishers using lift net, negatively affected by hilsa catch ban.

3.2. Conflict between fishers and fish entrepreneurs (*aratdar/mohajon*)

Since the hilsa fishery is a capital intensive economic activity, most fishers without collateral do not have access to loan facility of scheduled bank. Thus informal loan (*dadon*) from fish entrepreneur (*aratdar*) is only source of finance. In return, *aratdar* buy catch at a lower price than the market value. Sometimes conflicts arise between *mohajon (*boat owner*)* and fishing crew when the latter perceives injustice on profit sharing or wage payment because the former has connection with powerful local political leader, thus tries to deprive hired fishers of their alleged compensation. Benefits of hilsa fishing are unevenly distributed among different groups in fish chain. Several respondents indicated that a major part of their fishing benefit from the hilsa fishery goes to middlemen (*aratdar* and *mohajon*) before reaching the consumer market (Photo 2.5). Though *aratdar* and *mohajon* provide multiple supports to fishers, but they also demand high interests from the loan. Excessive pressure to pay loan compels many marginal fishers to engage in illegal fishing during the ban period. *Aratdar* provides necessary resources to apprehended fishers to continue fishing during the ban season. For instance, if fishers get arrested, respective *aratdar* can provide legal support or protective security. In a similar fashion, the micro-credit loan from NGOs can also push fishers to resort to illegal fishing for repayment (Table 2.1).

Photo 2.5. A number of intermediaries in hilsa marketing channel disfavor fisher to get fair price.

3.3. Conflict between fishers and various institutions

Imposition of a fishing ban brings economic hardship to full time fishers who do not have other alternative occupations. The compensation (i.e., PES) that fishers receive from the government is of insufficient quantity requiring extra cash support for satisfying other essential costs for family such as children's education. Thus, the ban of hilsa fishing pushes marginal fishers into poverty. Moreover, not all fishers are included in the PES scheme. Key fishery players such as *aratdar* do not receive any compensation for their lost earnings from fishing business. Consequently, non-compliance of the ban season is rampant. Particularly, the majority of the fishers use destructive monofilament gill net (*current jal*) (Photo 2.6). When law enforcing agencies seize illegal fishing gears, fishers buy gears again by taking microcredit loans from NGOs or taking *dadon* from the middleman. Fishers also need to take out a loan to meet subsistence living costs. Thus, the majority of fishers became indebted. Other forms of punishment such as seizing hilsa catch, monetary fines and imprisonment also make fishers vulnerable to economic crises. However, all fishers do not experience the same degree of vulnerability. There are allegations that fishers give a bribe to some corrupt police for continuing fishing. Here, conservation initiatives would further suffer due to corruption.

3.4. Conflict among various agencies of GoB

Local government administration, *Union Parishad*[1], selects the beneficiary list of the PES program. Excluded fishers complain nepotism and corruption in preparation of the list. Due to connection with political power, a section of non-fishers are included in the beneficiary list, while many marginal fishers are left out. Some fishers argued that irregularities in the compensation scheme create social tension. Institution has an important role to play in conflict resolution too. The DoF takes different initiatives (such as PES and support for alternative livelihood option) to improve the livelihood of the hilsa fishing communities as

mentioned above which are implemented through Upzilla Fisheries Officer. However, there are complaints that some officers and staffs do not follow the instructions of high officials accurately. At a local level, during an illegal-fishing raid of the DoF, local government administration and law enforcers jointly conducted the operation. However, there are disputes in managing the raid. The DoF complains that it does not receive support from other two departments during emergency needs. Also, local government administration receives a bigger grant allocation than local DoF officials for ban season monitoring, but the activities of local DoF official allegedly require more budget than the former one. Some officials complain that checking illegal fishing is not successful since some police takes bribes and sends information to fishers before raid starts.

Photo 2.6. Widespread use of illegal monofilament gill net is blamed for destructive fishing in the sanctuaries.

Table 2.1. Conflicts and cooperation among different stakeholders in the hilsa fishery in Meghna River.

Stakeholder interaction	Conflict	Co-operation
Fisher-Fisher	• Competition for inclusion to Payment for Ecosystem Services (PES) • Unfair profit distribution or irregular payment between boat owner and crew • Competition for fishing space	• Daily supports as colleague and well-wisher • Instrumental supports (comfort, money and food) during crises period such as illness, disaster, or persecution for non-compliance
Fisher-Fish entrepreneur (*Aratder/Mohajan*)	• Debt bondage cause selling fish at lower price • Fishers sell fish to other buyers • Some fishers' delay to pay loan • Attach productive assets of fishers in case of default	• Provide dadon for buying and maintenance of fishing productive assets • Provide loan for buying daily necessities • Provide protective security from subjective insecurity
Fisher-Local Government Administration (*Union*	• Nepotism and corruption in PES beneficiary list antagonize deprived	• Prepare beneficiary list of Payment for Ecosystem Services

Parishad)	fishers	(PES) program • Distribute PES to fishers • Distribute emergency relief after any disaster • Responsible for maintenance of physical infrastructure
Fisher- NGOs	• High interest rate of microcredit • Fishers utilize microcredit to buy illegal gears such as monofilament gillnet	• Provide micro-credit, training and asset for alternative income generating activities • Campaign and advocacy for women empowerment
Fisher- Law enforcing agencies (Police, Coast guard)	• Allegation of bribery and harassment • Allegation of allowed illegal fishing	• Ensure safe fishing environment by preventing criminal gangs
Fisher- Department of Fisheries (DoF)	• Fishers opined DoF don't consider their opinions in developing fisheries management strategy • Less field visits of DoF officers makes alienation with fishers that hamper biodiversity conservation	• Co-ordinate and distribute PES among fishers • Awareness building campaign among fishers about hilsa conservation
Department of Fisheries- Law enforcing agencies	• Sometimes Department of Fisheries failed to prevent illegal fishing due to some corrupted law enforce personnel	• Department of Fisheries, Police and Local Government Administration work by collaborating each other for development of fisheries resource
Department of Fisheries- Local Government Administration	• Disagreement in decision making • Local Government Administration gets more allocated money than Upzilla Fisheries Officer (UFO), though UFO is the core office for the management	• Collaborate in the distribution of PES and drive operation to check illegal fishing

4. Reflections

Globally fishers' conflict is mainly related to harvest (Charles 1992) which is also evident in the hilsa fishery context, where multiple stakeholders have competing interests on a single species. Reportedly the production of hilsa increased after declaration of sanctuaries; however, fishers' socio-economic conditions deteriorated due to lost harvest during a ban season. A section of fishers, with support from local elite continues fishing during ban periods to maximize their benefits. Thus in hilsa sanctuaries, illegal fishing continues on and weak institutional capacity is unable to control the access of resources that ultimately hamper conservation and increase social tension (Dnes 1985). In absence of necessary supports from the state, fish entrepreneurs provide fishers protective security and buffer against economic crises. However, the entrepreneur's investment causes over-capitalization in the fishery which, coupled with their push for maximizing benefits, leads to over-exploitation and

dissipation of potential economic benefits (Gordon 1954). To maintain their daily income and to satisfy the need of entrepreneurs to make profits from fishing, hilsa fishers target whatever they get- juvenile or berried, using destructive fishing gears. Microcredit from NGOs could have been an alternative source of financial capital; however, it proved largely ineffective. Excessive pressure to repay microcredit often force fishers to do illegal fishing. Thus both *dadon* and microcredit entrapped fishers into an endless cycle of debt and non-compliance of fishery regulations.

The conflicting situation between socio-economic needs and conservation measures revealed inherent trade-offs between these the two goals in hilsa fishery. Hilsa conservation strategy emphasize on the protection of the species from recruitment and growth overfishing, which achieved some success at short-term socio-economic costs of fishers. However, the issues of fair distribution of benefits in fish chain as well as socio-economic considerations of dependent fishers have not been adequately addressed in management plans, which ultimately undermine the success of conservation through illegal fishing. Success of providing PES to the hilsa fishers in controlling illegal fishing is complicated, since many fishers still continue fishing even if they receive the incentives to not-to-fish during ban periods. Particularly, during the 8-month ban on netting of juvenile hilsa (*jatka*), the majority of the interviewed fishers defy the restrictions and catch indiscriminately by using destructive fishing gears such as monofilament gillnet. Hilsa fishers' goal to maximize present economic profits at any costs by compromising long term benefits creates further trade-offs. Since scientists postulated that harvesting young, pre-reproductive fish species will generally result in non-equivalency in fish population, which negatively affects provisioning service of the fisheries and the socio-economic status of the associated communities (Shelton et al. 2014).

In the above-mentioned context, policy makers facing challenges in balancing conflicting interests related livelihoods needs and hilsa conservation. Such a balance could be achieved by augmenting co-operative relationships that exist among different stakeholders in hilsa fishery. As the table 2.1 illustrated, a relationship between two stakeholders is not just always one-sided, but there are simultaneously cooperative aspects to any conflicting relationship. The GoB's supports for the incentive program and alternative occupations need to be in sufficient quantity and be made more inclusive and transparent for all hilsa fishers. It is clear that better cooperation between the government and other stakeholders (fishers, *aratder*, local government official, NGOs, etc.) is necessary for successful conflict management (Jentoft and McCay 1995). The GoB could build up partnership with NGOs for training and asset building for long term alternative income generating activities, which will reduce dependency on fisheries-related jobs. Further synergistic relationships between fishers and the authorities could be built in terms of sharing responsibility for enforcement of conservation regulations, selecting appropriate alternative income-generating activities, increasing women participation in alternative occupations, and enhancing awareness building campaign for more compliance of ban season. At present, hilsa fishers are rarely consulted with prior to any changes being made in fisheries regulations, which contribute to the high level of non-compliance with ensuing conflicts.

Given that conflicts and social tensions negatively affect the well-being of the hilsa fishers, fishery co-management could be an effective solution for building a synergistic

relationship among resources users and government which will ultimately lead to poverty reduction and fishery conservation. Across the world, fisheries co-management is considered as one of the most practical and effective solutions to reduce resource conflict levels and increase civil order (Charles 1992; Bennett et al. 2001; Pomeroy et al. 2007). For instance, Bennett et al. (2001, p. 374) argued that "It is likely that a close alliance between government and local stakeholders (e.g. co-management) is a pre-requisite for successful conflict management in tropical fisheries. Co-management facilitates increased communication and understanding among all concerned, at least in principle, thus can minimize social conflicts and maintain or improve social cohesion for synergistic relation (Pomeroy and Rivera-Guieb 2005). Co-management enables redistribution of power and responsibility in the fishery that could mitigate potential conflicts related to power relations and allocation of resource (Bennett et al. 2001). Participatory resource management by co-management has the aim of helping resources users to become resource managers who can manage the hilsa fishery in sustainable, equitable and efficient ways. Co-management will increase legitimacy of the fisheries governance which will lead to improved compliance of laws. In designing co-management plans for the hilsa fishery, the simultaneous conflict/cooperation that exists in different fishery stakeholders should be considered to make the hilsa co-management model more effective and compliant.

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Note

[1] Union is last and third lowest tier of local administration system. Upzilla is the second lowest tier, whereas district is the first tier of local administration system in Bangladesh.

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CHAPTER 3

Managing Upper Lake Constance Fishery in a Multi-Sector Policy Landscape: Beneficiary and Victim of a Century of Anthropogenic Trophic Change

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Abstract Upper Lake Constance (ULC) is a large pre-alpine lake situated between Austria, Germany and Switzerland (9°18'E, 47°39'N). Along with the smaller, conjoined expanse of Lower Lake Constance, it forms the third largest lake in Europe. Its waters underwent pronounced eutrophication during the 20th century. Commercial fisheries benefitted strongly from the increased productivity during an initial mesotrophic phase, but these advantages were effectively neutralized when eutrophication became severe. By the turn of the 21st century, internationally coordinated measures to reduce nutrient input to the lake had returned ULC to its historic reference state as an oligotrophic ecosystem. However, the remarkable success of the nutrient management program has been to the detriment of commercial fishers. Yields of most commercially important fish species have decreased, along with lake productivity. As a consequence, the high market demand for local fish products is nowadays met mainly by imports, the ecological footprint of which offsets the local benefits of environmental restoration. Responsibility for fisheries and environmental aspects of ULC managing is shared by the national and federal state administrations and in all cases, tourism, drinking water and environmental interests now take priority over fisheries. As a result, the number of fishers operating viably on Germany's largest inland water body continues to decline and the long-term viability of commercial capture operations is in doubt. Aquaculture of locally desired fish species may become an important factor in the future of the Lake Constance fisheries.

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1. Lake Constance's Fish Community

Lake Constance has a total surface area of 536 km² and is divided into a large (472 km²), deep (z_{max} = 254 m, z_{mean} = 101 m) Upper Lake (Photo 3.1) and a small (63 km²), shallow (z_{mean} = 16 m) Lower Lake (Figure 3.1). This paper deals solely with the better documented warm-monomictic pre-alpine expanse of Upper Lake Constance (ULC) which has supported a regionally important fishery for many centuries.

Figure 3.1. Location of Lake Constance in Europe and between Germany, Switzerland and Austria.

Photo 3.1. Scenery of Upper Lake Constance.

More than 30 species of fish currently occur in ULC (Rösch 2014). The pelagic fish fauna is dominated by whitefish *Coregonus spp.* Four species of this highly important commercial genus were originally found in the lake: the pelagic spawning Blaufelchen (*Coregonus wartmanni* [Bloch 1784]), the nearshore spawning Gangfisch (*Coregonus macrophthalmus* [Nüsslin 1882]), the larger Sandfelchen (*Coregonus arenicolus* [Kottelat 1997]), and a deep-water dwarf species known as Kilch (*Coregonus gutturosus* [Gmelin 1818]). The latter disappeared from ULC between 1970 and 1980 as a result of oxygen depletion of the hypolimnion (Eckmann and Roesch 1998). Beside whitefish, ULC also supports good numbers of Eurasian perch (*Perca fluviatilis*), several cyprinids including bream (*Abramis brama*) and roach (*Rutilus rutilus*), and a number of predatory species, in particular pike (*Esox lucius*), Arctic char (*Salvelinus umbla*) and lake-dwelling brown trout (*Salmo trutta*). Since 2013, the non-endemic three-spined stickleback (*Gasterosteus aculeatus*), a small fish species of no commercial importance, has been building huge stocks. Sticklebacks now dominate the pelagic zone of the lake, competing with *Coregonus* spp. for daphnia and in all likelihood preying on eggs and larvae of these and other commercially significant species.

2. The ULC Fishery

The various whitefish species present in ULC have been the mainstay of local fisheries for a century (Photo 3.2), with the Eurasian perch becoming the second most important catch since the 1950s. Other species of commercial interest are pike, eel (*Anguilla anguilla*), Arctic char, lake-dwelling brown trout and pikeperch (*Sander lucioperca*).

Independent regulation of local fisheries around Lake Constance began as early as 1350, in an effort to manage competition (Zeheter 2015). However, those early efforts proved inadequate as they did not cover the whole lake. Finally in 1893, after calls for wider regulation from local fishers' organizations and lengthy negotiations, the federal German states of Baden, Bavaria and Württemberg joined Switzerland and Austria in signing the Bregenz Agreement, which remains the legal framework for the regulation of ULC fisheries to the present day (IBKF 1893). As a condominium, the lake has no borders, and its entire area (except those less than 25 m deep) is open to all fishers regardless of nationality. Commercial fishing licenses are granted by Austria, Switzerland and the German federal States of Bavaria and Baden-Württemberg, and the number issued has been controlled since 1914.

Since 1893, ULC has been managed by a political decision-making board that meets at least once a year. The board, known as the IBKF (Internationale Bevollmächtigtenkonferenz für die Bodenseefischerei, or International Conference of Plenipotentiaries for Fishery in Lake Constance, www.ibkf.org) is advised by a group of local fisheries experts. This expert group meets at least twice a year in order to consider the latest monitoring data and the wishes of fishers and anglers (numbering around 13000) and to propose adjustments to harvest regulations such as minimum-landing sizes, closed seasons, mesh sizes and other effort controls. Its recommendations for changes to fishing rules are passed to the political board (IBKF). Most monitoring data are generated by fisheries administrators or local research stations in each country. The yields of all professional fishers have been recorded regularly

since 1910, and records of all fishing licenses issued have been kept regularly since 1982. Single data for issued licenses before 1982 exist for the years 1914, 1931 and 1934, missing data were interpolated for the period 1934-1982.

Photo 3.2. Fishermen from Upper Lake Constance at work.

3. Dynamics of Anthropogenic Trophic Change

The waters of ULC underwent pronounced eutrophication during the 20th century owing to nutrient input in the form of municipal waste and agricultural run-off. Concentrations of phosphorous (P) measured during winter mixing (February–March (P_{mix}) increased from 7 $\mu g \cdot L^{-1}$ in 1951 (oligotrophic conditions) to >80 $\mu g \cdot L^{-1}$ around 1980 (eutrophic conditions) (Stich & Brinker 2010, IGKB 2014). These changes had profound effects on the lake's ecology. In particular, the increased nutrient load promoted algal growth, which in turn influenced characteristics including subsurface light penetration and the structure and function of lake food webs (Gaedke 1998). Due to strong bottom-up effects in the food web (Downing et al. 1990, Thomas and Eckmann 2007) eutrophication led initially to a sharp rise in fish production in the lake. However, negative consequences of the anthropogenic nutrient loading soon became obvious, in particular algal blooms and loss of water clarity (Zintz et al. 2010). In 1951, on the advice of the International Union of Lake Constance Fishers (Internationaler Bodensee Fischereiverband, IBF), the IBKF founded a working group on waste water management (IBKF 1951). However, this group had neither a mandate nor the political influence to initiate internationally coordinated measures to reduce nutrient loading. On the recommendations of the IBKF, the tri-national Water Quality Protection Commission of Lake Constance (Internationale Gewässerschutzkomission für den Bodensee, IGKB) was founded in 1959. This commission of environmental administrators initiated several coordinated measures including sewage collection, installation of sewage treatment plants in the catchment area and the incorporation of P precipitation into routine sewage treatment

processes. To date, the total costs for these measures amount to about 5.4 billion US dollars (igkb.org). Parallel measures to reduce phosphate levels in detergents were initiated in all three nations and as a result, P inputs to ULC were drastically reduced, and the lake was restored to an oligotrophic state by the beginning of the 21st century.

The uses of ULC and its surroundings have changed in other ways over the last 100 years. Local tourism and leisure industries have burgeoned and the region currently registers more than 18 million guest nights per year (www.statistik-bodensee.org/index.php /tourismus.html). Ferry traffic has also increased, with more than 10 million person crossings recorded in 2000 (Zintz et al. 2010). ULC is also famous for recreational sailing and serves as a resource for an increasing range of other outdoor pursuits. The number of registered pleasure boats on the lake increased from around 39000 in 1980 to nearly 57000 in 2000 (Zintz et al. 2010). Docks, moorings, buoys for boats and swimming beaches impact significantly on the productive shallow water zone, and in 2000, 45% of the entire 273 km shoreline of Lake Constance was considered strongly modified, for example by straightening, embankment or construction (IGKB 2009, Zintz et al. 2010). Meanwhile, ULC water has become an ever more important resource, with more than 4 million people currently relying on it for drinking water (Zintz et al. 2010).

4. Ecological Consequences of Anthropogenically Modified Nutrient Dynamics

The trophic condition of lake water influences fish growth through bottom-up control of secondary production (Downing et al. 1990, Müller et al. 2007). Crustacean zooplankton is the main food source of pelagic fish in ULC. During the peak eutrophication of the 1960s and 1970s, their average annual density over the entire water column increased from 4×10^5 individuals·m^{-2} to over 10^6 individuals·m^{-2} (IGKB 2004). By the turn of the 21st century, following the implementation of nutrient input controls, these values had returned to pre-eutrophication levels (IGKB 2004, Stich and Brinker 2010, Thomas and Eckmann 2007). Whitefish living in ULC during the 1970s grew nearly 10 cm longer in their second year of life compared with those in the 1950s and 1990s when P-levels were lower (Thomas and Eckmann 2007). Although enhanced growth rates might be expected to increase fish production and yield, the high P levels also brought negative effects for the variability of standing stock and age structure. For example, from the late 1960s to early 1990s, whitefish biomass showed strong inter-annual variation, with the lowest value documented in 1967 (below 30 metric tons [mt]) (Thomas and Eckmann 2007). During that time, fish grew very rapidly and entered the fishery at a young age. The majority of stock was made up of fish less than three years old, and an increasing fraction of commercial yields consisted of age-1 fish that had not yet reproduced. By contrast, during a phase of increasing P-concentration in the 1950s, and again from the late 1980s to 2005 when P levels were declining, standing stocks of whitefish typically included five or six age classes, and standing stock biomass was relatively high and stable (Thomas and Eckmann 2007). In more recent years, with P-levels comparable to those of the 1940s and 1950s, whitefish growth rates have decreased dramatically (IBKF 2015).

The disappearance of the dwarf *Kilch* whitefish species from ULC during the eutrophic phase (Eckmann and Roesch, 1998) is attributed to sediment surface conditions detrimental to egg survival. Hypoxic conditions resulting from algae bloom caused by high P loads almost lead to the extinction of Arctic char in the 1970s. Lake-dwelling brown trout also suffered, as a result of losses of stream habitats suitable for spawning (Hartmann 1984; Ruhlé et al. 2005). Populations of both species have stabilized through improved natural recruitment since measures were taken to control eutrophication. Whitefish, Arctic char and trout are also subject to stock enhancement by stocking, which has been carried out in ULC for more than 120 years (Rösch 1993). Stocking effort increased steadily in the late 20th century, from approx. 27 million larvae in 1963 to 441 million in 2002 (Thomas 2009). Despite this effort, yields of whitefish continue to fluctuate widely and the decline in catch since 2010 has not been mitigated, lending support to models that question the value of fry stockings in naturally reproducing stocks (Lorenzen 2005).

Eurasian perch, the second-most important fishery target in ULC, also reacted to changes in food availability. Prior to eutrophication, adult perch were mainly predatory, but they switched almost completely to zooplankton (mainly daphnia) between the 1960s and late 1990s, and built to very high levels of abundance when P-levels exceeded 10 – 15 µg·P L^{-1}. When P-levels subsequently dipped below this threshold, adult perch became predatory once more and standing stock size decreased substantially (Eckmann et al. 2006).

The anthropogenic modification of the ULC shoreline has been problematic for species that rely heavily on intact and macrophyte-rich littoral zones, including perch and cyprinids, which have lost significant areas of their spawning and nursery grounds (Deufel et al. 1986; IGKB 2009). Efforts to restore some littoral areas began in the 1990s (Zintz et al. 2010), and subsequent evaluations have shown increased numbers of young fish in these restored zones compared to degraded areas (www.firebo.eu).

5. Consequences of Nutrient Dynamics for Commercial Fisheries

Changing P-level is the most significant factor impacting on ULC fisheries. From the perspective of commercial fisheries, P driven developments over the past 105 years can be grouped into five phases: I) 1910 to 1955, II) 1956 to 1969, III) 1970 to 1989, IV) 1990 to 2005, V) 2005 to the present day (Figure 3.2).

Phase I (1910-1955): ULC was oligotrophic (P_{mix} = < 10 µg L^{-1}) and fishery yields were low, but relatively stable ($mean_{1910-1955}$ ± SD [standard deviation] = 423 ± 134 mt, CV [coefficient of variation] = 31 %; Figure 3.2). By mass, nearly 70% of fish landed were whitefish ($mean_{1910-1955}$ ± SD = 289 ± 100 mt, CV = 34 %), but the proportion of perch increased from 5% in 1910 to 15% in 1955 ($mean_{1910-1955}$ ± SD= 47 ± 35 mt, CV = 74 %). During this phase, annual catch per license was comparably low (mean ± SD = 2.4 ± 0.6 mt, CV = 25 %; Figure 3.3). At the end of the 19th century, about 400 professional fishers operated on ULC (IBKF 1895). The number of licenses was capped for the first time in 1914, at 435 (IBKF 1914), but the high impact of fishing and the low production potential of the lake meant that not all the available licenses

were issued. In 1931, 273 fishermen were licensed to fish in ULC (IBKF 1934) and in 1934 the maximum number of available licenses was revised significantly downwards to 218 (IBKF 1934). While fishers were restricted by regulations controlling effort, their operations were expected to be profitable because the cap on licenses ended the race-for-fish and aimed to secure a small, but stable yield for each licensee.

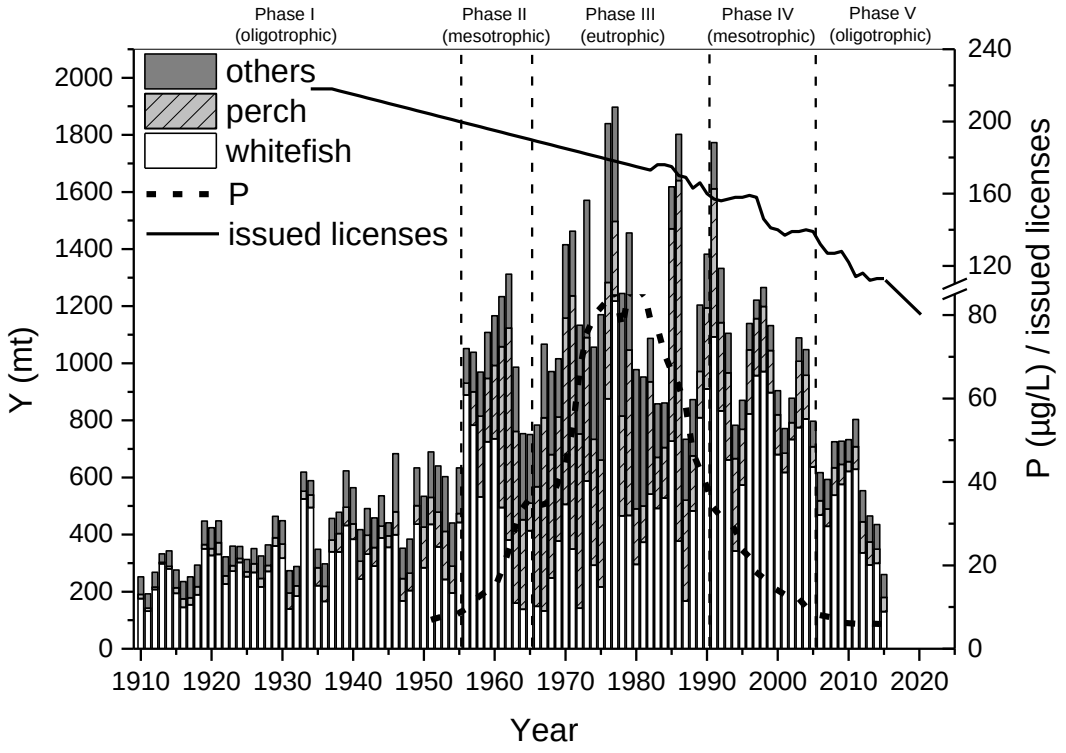

Figure 3.2. Fisheries yield in metric tons (mt) for whitefish (white columns), perch (grey, dashed columns) and other fish species (dark grey columns) between 1910 and today; the yield for 2015 is estimated. The P-level between 1951 and 2015 is the dashed black line and the number of issued fishing licenses in ULC between 1934 and 2020 is the solid line (data between 1934 -1982 and 2015-2020 were interpolated); note the discontinuity of the right y-axis. Phases group the trophic change during the last 100 years.

Phase II (1956-1965): During this mesotrophic phase P-levels rose from 10 to 35 µg·L^{-1} and yields increased accordingly. Total annual yield exceeded 1000 mt (1956) for the first time in 1956 and went on to average 1035 ± 185 mt (± SD; CV = 18 %) (Figure 3.2) between 1956 and 1965, with a maximum of 1310 mt in 1963. Compared to phase I, total whitefish yield ($mean_{1956-1965}$ ± SD = 525 ± 258 mt, CV = 49 %) and annual total catch per license ($mean_{1956-1965}$ ± SD = 5.3 ± 0.9 mt, CV = 17 %; Figure 3.3) had doubled, and yields of perch ($mean_{1956-1965}$ ± SD = 324 ± 236 mt, CV = 72 %) were six times higher than under oligotrophic conditions. Local demand for fish could be easily fulfilled and a proportion of the catch was regularly sold outside the ULC region. During this time, the possibility to earn relatively easy (and good) money in the growing industries around Lake Constance led some fishermen to give up their business, resulting in a small reduction of issued fishing licenses (Figure 3.2). The same period

also saw a change in fishing techniques, from traditional 'Klusgarn' seine fishing to more size-selective monofilament nylon gillnets. Because whitefish growth rates at the time were high, a rapidly apparent effect of this size-selectivity was an increasing number of age-1 whitefish in the catch (Gum et al. 2014). The obvious risk of recruitment overfishing was counteracted by a moratorium on pelagic whitefish fishing for the 1964 season and then an increase in the minimum mesh size from 38 – 40 mm to 44 mm from 1965. The legal catch size for whitefish was also increased, from 30 cm to 35 cm (IBKF 1964, 1965). Due to those measures the annual whitefish catch per license decreased for two years (from $mean_{1955\text{-}1963}$ ± SD = 3.2 ± 0.9 mt, CV = 29 % to $mean_{1964\text{-}1965}$ ± SD = 0.8 ± 0.1 mt, CV = 9 %; Figure 3.3). Compliance with fisheries regulations had been enforced by fishery wardens since the 1950s and was probably therefore high. All in all, high yields more than compensated for stricter regulation and rendered this mesotrophic phase a "golden age" for ULC fishers.

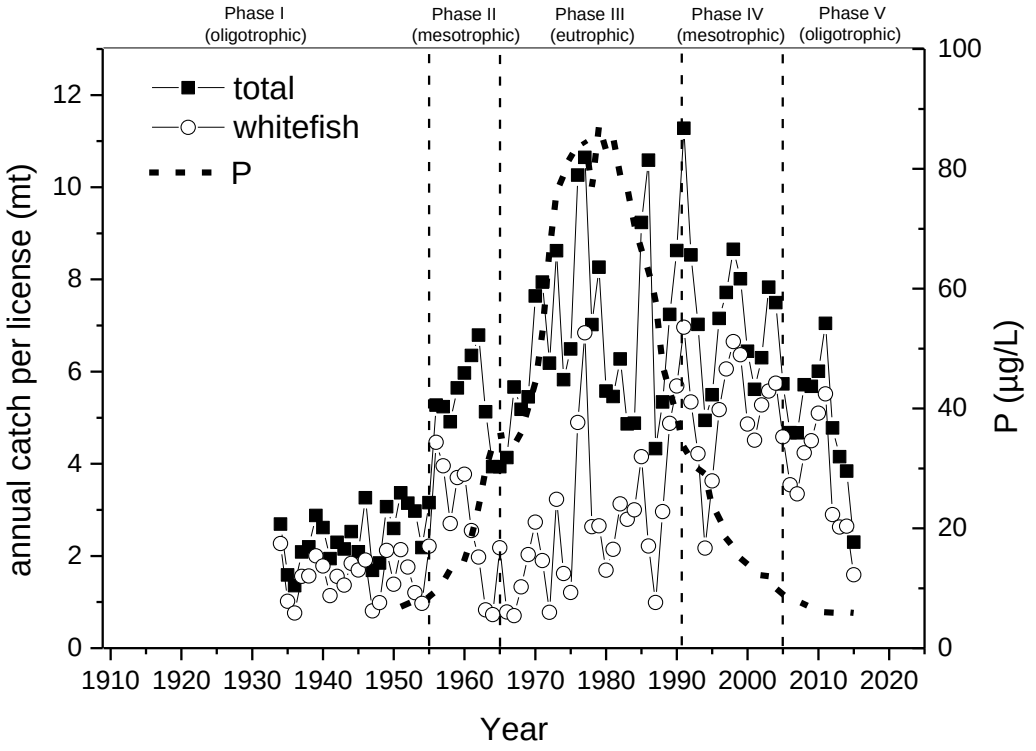

Figure 3.3. Catch per license in metric tons (mt) for total catch (grey squares) and for whitefish catch (white circles) between 1934 and today, the P-level between 1951 and 2015 is the dashed black line. Phases group the trophic change during the last 100 years.

Phase III (1966-1990): During this eutrophic phase, P-levels consistently exceeded 35 $\mu g \cdot L^{-1}$ and peaked in 1979 at 87 $\mu g \cdot L^{-1}$ (Figure 3.2). Disadvantages of excessive nutrient inputs to fisheries became apparent, with natural recruitment of all whitefish species and Arctic char suffering from low oxygen levels in the hypolimnion. Indeed, highly prized Arctic char almost disappeared from the catch (Rösch 2014). At the same time, numbers of low-priced or barely marketable cyprinid fishes such as bream and roach captured in the pelagic zone increased (Hartmann 1977; Nümann 1972). In consequence, while total annual yields remained fairly

high ($mean_{1966-1990}$ ± SD = 1.215 ± 339 mt, CV = 28 %), annual whitefish catch per license ($mean_{1966-1989}$ ± SD = 2.7 ± 1.6 mt, CV = 59 %) did not increase further and was very unstable (Figure 3.3). Yields of perch were high but unstable as well ($mean_{1966-1990}$ ± SD = 448 ± 260 mt, CV= 58 %), and at beginning of the eutrophic phase poor filet quality and high parasite loads in perch were reported (IBKF 1966). The overall efficiency of gillnet fishing was reduced by blooms of algae that fouled the nets in midsummer (Thomas 2009). Towards the end of phase III, demand for fishing licenses decreased, most likely due to diminishing yields, and the number issued fell from 173 in 1982 to 160 in 1990 (Figure 3.2).

Phase IV (1991-2005): During this second mesotrophic phase, whitefish yield rebounded to a relatively stable level ($mean_{1991-2005}$ ± SD = 760 ± 186 mt, CV = 24 %) and sometimes exceeded local demand, as evidenced by exports to other regions of Germany. Perch yields remained at an acceptable level for 10 years ($mean_{1991-2000}$ ± SD = 259 ± 112 mt, CV = 43 %), but subsequently fell below 75 mt in 2001, 2002 and 2005, their lowest since the early 1950s (Figure 3.2). Even so, the high total annual catch per license ($mean_{1991-2005}$ ± SD = 7.2 ± 1.6 mt, CV = 22 %; Figure 3.3) and high whitefish catch per license ($mean_{1991-2005}$ ± SD = 5.1 ± 1.2 mt, CV = 24 %; Figure 3.3) marked this as a second "golden age" (*cf*. phase II) for ULC fishers.

Phase V (2006-present): From 2006 onwards, conditions in ULC returned to oligotrophy (P-level below 10 µg L^{-1}, Figure 3.2), and whitefish yields decreased to levels comparable with the 1950s ($mean_{2006-2014}$ = 465 ± 135 mt, CV = 29 %). A further decline has become apparent in the last four years. From 2012 to 2014, mean whitefish yield was only 309 mt (Figure 3.2) and the total annual catch per license fell below 4 mt (Figure 3.3). It is expected that figures for 2015 will show a further decline in yield to below 150 mt in total and less than 2 mt per license. Perch yields are also very low ($mean_{2006-2014}$ ± SD = 70 ± 24 mt, CV= 34 %). These figures threaten the economic viability of fishery operations (Straub & Meier 2010). Furthermore, increases in the yield of Arctic char since the mid-2000s have leveled off and catches are now comparable to those of lake-dwelling brown trout. Combined catches for these two species are now less than 20 mt per year. ULC fisheries can no longer meet demand for locally caught fish. In 2015, as in 1914 and 1934, a decision was made to further reduce the number of fishing licenses. From 2020 only 80 professional fishers will be permitted to fish in ULC (IBKF 2015). Compared to the number of licenses issued in 2006 (132) this will constitute a reduction of 40 % in just 15 years, despite continued high market demand. Today, it seems inevitable that the remaining professional fishers will be obliged to engage at least partly in whitefish aquaculture schemes being developed by local researchers (FFS 2015) and promoted by the agricultural administration of Baden-Württemberg, or to increase their income by purchasing and processing imported fish. The alternative is economic extinction.

6. Possibilities for Tackling the Problems in a Nutrient Mitigated System

Intensive, internationally coordinated measures have succeeded in restoring P levels in ULC to socially desired and legally required oligotrophic values and established an equilibrium in line with the contemporary environmental policies of ULC states, including the EU Water Framework Directive (Landtag von Baden-Württemberg 2013; Schweizer Nationalrat 2013; IGKB 2013). However, the current prescribed oligotrophic state of ULC is not without problems; some of these are economic: the steep decline in nutrient load since 1980 has reduced growth and standing stock biomass of whitefish and perch to levels where a local inland fishery is no longer viable (Straub and Meier 2010). There is also an ecological cost. The decision to prioritize the regional environmental ideal of P concentrations close to Ice Age levels has popular support, but it likely raises significant ecological issues elsewhere by fostering the importance of alternative protein produced (Hilborn 2013). Other yardsticks for ecological impact, such as protein-energy return on investment, greenhouse gas emissions and land area requirement (Tyedmers 2004), suggest that the capture and local marketing of wild fish from ULC is one of the most environmentally sustainable forms of animal food production available (Lynch et al. 2016). Local demand for fish is very high, given the substantial size of the local human population and the millions of tourists that visit the region each year. This demand is currently met mainly by fish imports (Dreßler 2013). In 2012 at least 50 % of all whitefish consumed at ULC originated from other countries, including Italy, Finland, Iceland and Canada (Dreßler 2013). Those imports come by plane or truck, an increasingly controversial practice in terms of ecological footprint, which lacks a certain transparency to consumers (Madin and Macreadie 2015). Diners may assume that as a regional specialty, the fish on their plate is fresh from the lake, when in fact it will often be a frozen fillet from another continent.

The decline of ULC fisheries yield is not a result of changing demand or poor fisheries management, but an exclusive consequence of the otherwise highly successful nutrient management measures deliberated and agreed at political levels beyond the core fisheries sector. These changes have impacted heavily on local fisheries and also consumers through substitution of local products by foreign fish of largely unknown origin, at substantial higher ecological cost.

Meanwhile, other environmental threats to the lake are increasing, particularly such as those resulting from transportation, tourism, the heavy use of productive shallow water zones and negative impacts of climate change (Straile et al. 2007; Stich and Brinker 2010; Wahl 2009). ULC is also polluted by a variety of pharmaceuticals, microplastics, and other chemicals, but these have received nothing like the attention focused on P. Furthermore, after more than 100 years of inconspicuous occurrence, the abundance of non-endemic three-spined stickleback in the pelagic zone has risen sharply in the last three years. Sticklebacks have the potential to outcompete other fish species (Bergström et al. 2015; Byström et al. 2015), and according to recent research this seems to be the case in ULC. These multiple negative influences on the fish community render achieving fish stocks and yields comparable to their previous stable values at 1950s P-levels as unrealistic. Indeed, current trends indicate a future in which much lower yields will be the norm. It remains to be

seen whether the new maximum limit of 80 fishing licenses due to coming into force in 2020 will be low enough to sustain even a small number of viable commercial fisheries.

The precarious economic situation faced by the remaining professional fishers of ULC has led to calls for a moderate increase in permitted levels of P, to 10-12 µg L^{-1}. This slight elevation could be achieved by a small reduction in the quantity of precipitation agent used in sewage treatment. The fishers argue that such action would result in oligotrophic conditions only slightly above the currently prescribed reference state, and indeed similar to those that prevailed in years when ULC was celebrated for its exceptional high water quality by environmentalists, water authorities and tourism managers but when yields were also comparatively high (Figure 3.4). However, the public discourse strongly indicates that even a slight increase in P is currently unthinkable to the governments and their environmental administrations.

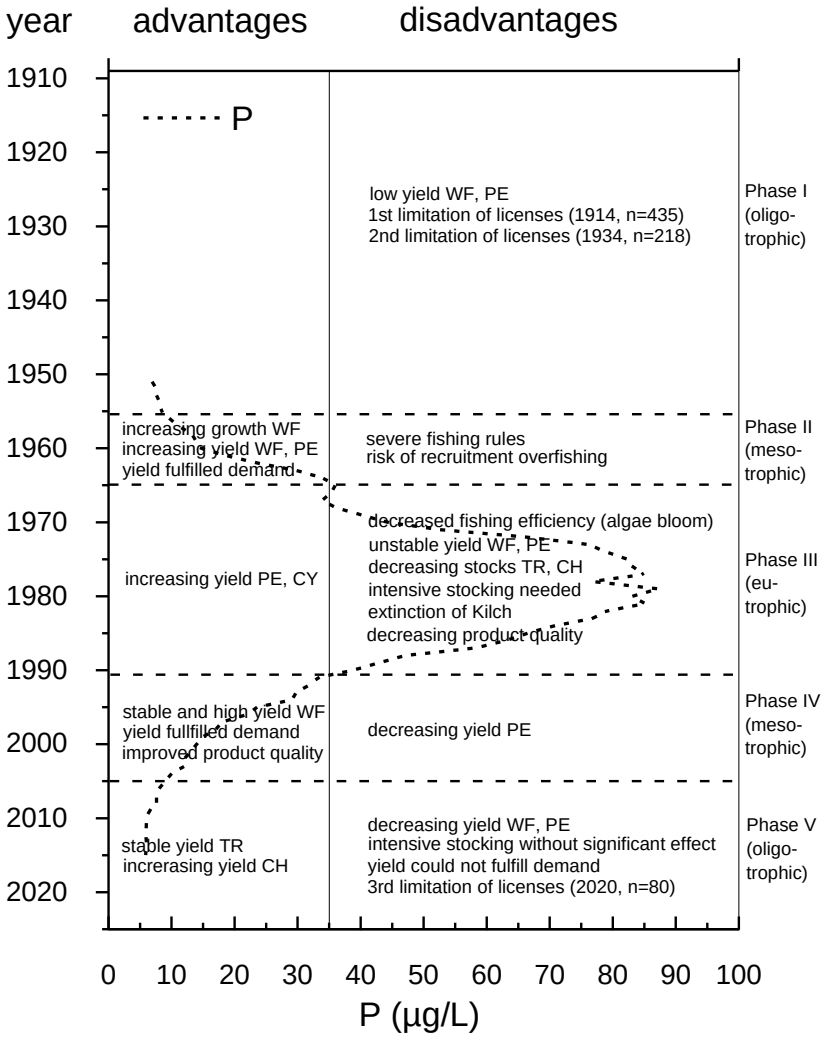

Figure 3.4. Advantages and disadvantages during eutrophication and re-oligotrophication of ULC from the view of the commercial fishers (WF = whitefish, PE = perch, TR = trout, CH = arctic char, CY = cyprinids). Phases group the eutrophication during the last 100 years.

A principle concern of leading authorities to insist on extremely low (Ice Age) P levels is the likely effect of ongoing climate change. With increasing temperatures and stronger stratification of the lake, the probability of holomixis at the end of winter is decreasing. Some model predictions assess that this will lead to lower oxygen levels in the hypolimnion (Landtag Baden-Württemberg 2013; Wahl 2009; Wahl & Peeters 2014). Earlier research predicts that P levels of around 10 µg L^{-1} would be sufficient to protect the lake from the stronger stratification that will develop as a result of increasing global temperature (Müller 2002), leading fishers to question the need for reductions significantly below this threshold. Indeed, the climate change argument may be moot in terms of nutrient loading. A recent report suggests that even with Ice Age P levels the lake is unlikely to escape the effects of temperature increases (IGKB 2015).

Another decisive factor behind resistance to elevated P is that under the EU Water Framework Directive, and in contrast to any other published limnological standards, ULC is regarded an alpine rather than a pre-alpine lake (Mathes et al. 2002). This designation carries an expectation of extremely low P-levels further undermining the fisher community's case for an increase.

A further new avenue under discussion is aquaculture, specifically the potential for whitefish reared in open net cages in the lake or in closed land-based farms to fulfill the demand shortfall in regionally caught whitefish. However, the high investment costs (even with subsidies) for aquaculture operations would exclude all but a minority of the current fisher community, especially given the recent economically disastrous years for the industry. The proposal may simply be too late for many. Furthermore, the majority of local fishers are culturally resistant to the idea of aquaculture. Some are operating as 13^{th} generation family businesses and wish to continue their centuries-old way of life. They see the traditional capture fishery as much more in line with regional and personal tastes and habits and argue that they are fishers, not farmers. One solution that may overcome some of these reservations is for a core group to found a cooperative aquaculture enterprise to produce a local product (whitefish raised in ULC-water and originated from local stocks). These fresh, consumer- and environmentally friendly products could then be sold locally through the fishers' existing direct marketing avenues, while maintaining important elements of the traditional fishery.

Local whitefish aquaculture may help to address the issues of fish supply and environmental impact, but from the view of the fishers as a solution it is second-best. It is somewhat ironic given their long experience in producing a highly sought-after, sustainable product, and their central role in highlighting the damage caused by eutrophication and proposing relevant and effective actions to improve water quality, the centuries-old professional fisheries of ULC are now mere spectators and commentators on policy. The fishers continue to provide a romantic backdrop for lake tourism but have little power to influence their own future or that of the lake.

7. Synopsis

Having played a central role in lake management and decision-making in the past, in particular during the eutrophic phase, ULC fisheries now find themselves second in terms of socio-political importance compared to environmental protection, tourism, water quality and outdoor recreation. The lake condition that would constitute an optimal solution from a fisheries perspective (i.e. P at about 10-12 μg L^{-1}) is anathema to prevailing societal concerns, including those of environmental protection organizations, and contravenes current interpretation of environmental policy such as the EU Water Framework Directive. However, the recent history of the commercial fisheries in ULC highlights some common pitfalls in environmental management, and the blind spots that can afflict even the most successful schemes. One such problem is a tendency to focus disproportionately on apparently successful measures, at the expense of progress with other urgent but less easily resolved problems (Butler 2002). The reduction of P-levels in ULC was initiated without a final target (lower limit) being set, and has been delivered with enthusiasm that has limited the consideration of available scientific knowledge and societal impacts. The ideal time to mitigate an emerging crisis is before it begins to bite. Of course predicting the future is difficult as is navigating all trade-offs, but the time to try is during periods of stability, when resources of money and time resources are available. The decline in ULC fishery yields in response to sharp P reduction was in fact predictable, but a blind eye was turned. As a result, the opportunity to investigate alternatives (such as aquaculture) in a timely fashion at the end of the second mesotrophic phase, was missed by all involved parties.

A further concern stemming from the crisis facing ULC fisheries is that alterations to the local food supply will inevitably have ecological and social ramifications in other parts of the world (Hilborn 2013). Current developments are set to substitute a product of exceptionally high sustainability (wild caught local fish) (Tyedmers 2004) with imports from foreign countries, thereby unintentionally expanding the ecological footprint of food production and neglecting a consumer preference for locally produced food.

It may be too late to save the ULC fisheries as an economically viable operation, given that none of the recent proposals to improve yields (P-increase, aquacultural development) seem likely to find widespread approval in time. Thus, a key conclusion must be that the objectives of environmental management and sustainable fisheries cannot be served without early engagement of all parties along the full parameter space of key environmental variables.

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CHAPTER 4

Inter-Sectoral Governance in Inland Fisheries: Lake Victoria

Fiona Nunan[1] & Paul Onyango[2]

Abstract The diverse uses of Lake Victoria, East Africa, and the scale of the lake, bordered by three countries and covering 68,000 km^2, mean that many government sectors and non-governmental actors are involved in the governance of the lake and impact on the fisheries. Inter-sectoral interaction happens at all levels but is not always frequent or well-coordinated – it may depend on the availability of funds and willingness of government officers and other actors to interact and work together. Examples of conflict and cooperation within and beyond the fisheries sector are provided, leading to the identification of opportunities to further and deepen collaboration between sectors.

1. Introduction

Fisheries tend to be governed in a sectoral way, with dedicated government departments, ministries and officers, and sectorally-defined and operated systems. However, the natural and social systems involved in fisheries do not exist and act in isolation of other components of the systems (Kooiman et al. 2005; Jentoft and Chuenpagdee 2009). Among other factors, fish are affected by water quality and temperature, plant growth and other animal species. People are affected by broader governance systems and their livelihoods are affected by decisions made in relation to water, agriculture and infrastructure, amongst other policy areas. This is particularly the case in inland fisheries, where the impacts of land-based activities have a significant effect on water bodies. For Lake Victoria, there are many areas of activity rooted in government sectors and local livelihoods that interact significantly, including agriculture, forestry and water management (LVBC 2007). The diversity of activities and the geographical scale of Lake Victoria and its fisheries make inter-sectoral governance a significant and complex challenge.

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2. Lake Victoria Fisheries and Their Governance

Lake Victoria is the second largest freshwater body in the world, with an area of 68,000 km^2, bordered by Kenya, Tanzania and Uganda, with the lake share respectively being 6%, 51% and 43% (see Figure 4.1 and Photo 4.1). The catchment area is estimated to be 193,000 km^2, serving around 30 million people, with 200,000 fishers active in the fisheries and an annual catch of 800,000 t whose value is approximated at US$ 590 million (LVFO 2016). There are three main commercial fisheries on the lake: Nile perch (*Lates niloticus*), Nile tilapia (*Oreochromis niloticus*) and the sardine-like dagaa (*Rastrineobola argentea*). These serve different markets, mainly international for the Nile perch and domestic and regional for the Nile tilapia and dagaa. The introduced species of Nile perch and Nile tilapia (in the 1950s and 1960s) led to a fishing boom in the 1990s, accompanied by the plummeting of stocks of the native cichlid species. This boom led to the commercialization of much of the fishery, with negative consequences for local processors and traders. There has therefore been some controversy about the fisheries, though within the countries there is much appreciation of the economic and livelihood benefits that have flowed from the introduced species and the commercialization of the fisheries. Over the last decade, increasing concerns have been raised about the sustainability of the Lake Victoria fisheries, particularly of the Nile perch, with the scale of the fishing effort and prevalent use of illegal gears and methods seen as threatening the future of the fisheries. Weak governance and enforcement has also contributed to this situation (SmartFish 2015).

Interest in Lake Victoria has always been dominated by fisheries. Even before the independence of the riparian countries, the diverse fisheries of the lake attracted more attention than any other activity (Graham 1929). This in essence defined the manner in which the lake has been perceived (Table 4.1). Literature on the lake indicates that the first regulations ever enacted for the lake, the Fish and Crocodile Laws in Kenya and Uganda and the Fisheries and Trout Protection Ordinance of the Tanganyika Territory (1950) (former Tanzania), targeted the fisheries.

Figure 4.1. Location of Lake Victoria in East Africa (Source: @2016Google).

Photo 4.1. Around 50% of landing sites are on islands in Tanzania and Uganda.

Table 4.1. Historical timeline of Lake Victoria governance.

Time	Institution/Regulation/Organization
Before 1900	Use of Beach seines as fishing gears by traditional communities
1908	Introduction of gillnets as preferred fishing gears
	Fish Protection Ordinance
1927	First lake wide fisheries survey by Graham
1933	5 inch minimum mesh size of gillnet introduced
1947	Formation of Lake Victoria Fisheries Service (LVFS)
	Issuance of fisheries licenses by LVFS
	Formation of East Africa Freshwater Fisheries Research Organization (EAFFRO)
1953	Issuance of licenses by LVFS extended to cover Tanzanian waters
1960s	Tanzanian Fisheries Division established
	Kenya's Fisheries Department
	Uganda's Fisheries Commission
	Fish and Crocodile Laws
1970s	First Fisheries Act in Tanzania enacted
	Decentralization of fisheries management to district level
1980s	Establishment of Fisheries Research institutes in the three countries
1990s	Fisheries Policy in the three countries
	Introduction of Co-management in the lake
	Formation of Lake Victoria Fisheries Organization (LVFO)
2000	Bringing in of additional state agents (Police and Judiciary)
	Local Government taking central role in the governing of Lake Victoria fisheries
	Private sector brought on board
	Civil society taking active role in the governance of the lake's fisheries

The organizations that existed in the 1960s to 1980s implemented their activities with minimal coordination at the lake level. Neither did they establish common goals or develop

common plans on how to govern; management rather than governance took centre stage. It was not until the late 1990s that coordination was improved through the activities initiated and funded under the World Bank and Global Environment Facility supported Lake Victoria Environmental Management Programme Phase I (LVEMP). Part of the coordination efforts in the 1990s was to re-establish a lake-wide fisheries organization, the Lake Victoria Fisheries Organization (LVFO), as the Lake Victoria Fisheries Service listed in Table 4.1 had been disbanded in 1960. LVFO was formed in 1997 under the remit of the East African Community (EAC), with a Secretariat for the organization based in Uganda. The Secretariat serves the core structures of the organization, comprising the Council of Ministers and Executive, Fisheries Management and Scientific Committees. The committees are made up of directors, or their delegated representatives, of the national fisheries directorates and national fisheries research institutes. From 2010, representatives of fishing communities and the private processing industry dealing with Nile perch (see Photo 4.2) joined the Executive Committee, as part of the adoption of a co-management approach. The mandate of the LVFO is to promote the sustainable management and development of fisheries and aquaculture in, among other areas, Lake Victoria.

The development of a co-management approach began in the late 1990s with LVEMP support, with the formation of community-based Beach Management Units (BMUs) to enable resource users to participate in the management of the fisheries, working with government and other stakeholders. Different approaches to the structure and operation of the BMUs were taken by each country and so harmonization of the co-management approach was facilitated by the LVFO through the EU funded Implementation of a Fisheries Management Plan (IFMP) project in the 2000s.

Photo 4.2. Loading Nile perch into a refrigerated lorry for transfer to a processing plant.

In January 2016, the LVFO Council of Ministers approved the incorporation of the Republic of Burundi and the Republic of Rwanda into the Convention of the LVFO, reflecting the expanding membership of the EAC. South Sudan joined the EAC in March 2016 and the Democratic Republic of Congo is also keen to join the EAC. The expanding membership of the

EAC and hence LVFO is expected to lead to a change in the name and remit of the LVFO, with potential consequences for the governance of the lake fisheries.

3. Inter-Sectoral Nature of Lake Victoria Fisheries

The fisheries of Lake Victoria have multiple relationships with other sectors at all levels. These relationships stem from activities within the wider Lake Victoria Basin as well as on and around the lake itself. Activities that impact the lake and its fisheries particularly include agriculture, urban development, forestry and hydropower.

Agricultural production is the main economic activity of the basin, with a range of cash and subsistence crops. Agriculture intersects with fisheries in multiple ways but the main two areas of intersection are: sources of employment and income, and the pollution of the lake from chemical fertilisers and pesticide use. People enter the fisheries having become frustrated at the lack of income from agriculture, both related to the level and frequency of income. In addition, many people engaged in fisheries also farm land (Geheb and Binns 1997). The increasing population and increased livelihood activities associated with agriculture and urbanization have brought pollutants to a level that has affected fish catches and fish biodiversity. Algal productivity has increased two fold since the 1960s and algal biomass has increased more than four times. Industries located in the major cities riparian to the lake, such as Kampala and Jinja in Uganda, Mwanza, Musoma and Bukoba in Tanzania and Kisumu in Kenya, have been discharging their effluents into the lake (Okedi 2005). Populations in these cities have equally discharged their waste into the lake. The cities have remained the main point sources of pollutants into the lake. Some studies have shown that Mwanza Gulf, Murchison Bay, Napoleon Gulf, Winam Gulf and around Kisumu areas have been major hot spots of pollution loading into the lake (Kling et al. 2001; Abila et al. 2006).

Lake Victoria is surrounded by numerous forests in the three countries. In Uganda, forests around Lake Victoria start from Jinja township and continue westwards along the northern shore of the lake, down the western shore and towards Tanzania. In Tanzania, forest are scattered all around the lake in the west, south and east. In Kenya, forest is found around the Kericho area and some parts of the western area. Deforestation affects run-off and water flows reaching the lake, as well as sedimentation and subsequent increases in eutrophication, with consequences for fish breeding and stocks (Sitoki et al. 2010). Fisheries and forests also interact through the use of timber for the construction of boats, as Lake Victoria fisheries are artisanal, with locally-made timber boats, as shown in Photo 4.3, the use of timber for house construction and provision of fuelwood and charcoal for cooking and smoking fish.

Lake Victoria is also critical to the Kiira and Nalubaale Hydropower Dams (formerly known as the Owen Falls Dam) in Uganda and the downstream Bujagali Dam, also in Uganda, which began operation in 2012. The dams have led to controversies in the region due to alleged over-release of water, leading to mistrust between the riparian nations and concern about the impact of falling water levels (Lubovich 2009).

Photo 4.3. Wooden artisanal boats make up the Lake Victoria fisheries fleet.

4. Conflict Within and Beyond Fisheries

Examples of conflict within and beyond fisheries can be found in border areas, particularly in relation to islands where the sovereignty is contested, and between fisheries-focused BMUs and village government. Conflict has at times arisen due to fishers moving across country boundaries in search of better catches and prices and not always securing the right permits and licenses to operate within the fisheries of the country they have migrated to (Heck et al. 2004). The main border area conflict has existed since 2004, when Uganda deployed forces in the area of Mgingo Island, declaring the island to belong to Uganda, disputed by Kenya (Shacka 2013). Discussions are still ongoing in 2016 between Kenyan and Ugandan officials to resolve this transboundary dispute (Baraza 2016), which has greatly affected the lives and livelihoods of fisherfolk in the area.

Conflict between BMUs and village government has on occasion arisen due to competition for power and resources at the beach level. Relations between BMUs and village government differ between locations, with examples of both conflict and cooperation. Formally, in Tanzania, BMUs report to the Defence Committee of the Village Council; there are no formal reporting arrangements in Uganda and Kenya to village government. In all three countries, the BMUs report to, and are supported by, the local level fisheries officer. Although the fisheries officers are employed by the local governments (County or District and lower levels), they also report to the departments of fisheries at the national level. The BMUs are therefore also seen as being part of the national fisheries department infrastructure, which creates challenges for decision-making and authority at the local level. Instances of conflict between BMUs and village governments or chiefs often revolve around illegal fishing activities. Some fisherfolk have accused village government members of engaging in, or turning a blind eye to, fisheries illegalities, at times leading to conflict between BMUs and village government. However, there are also examples of cooperation between BMUs and village government, for example in keeping beach areas clean, providing fish marketing facilities and working on sanitation projects.

5. Inter-Sectoral Cooperation

Inter-sectoral cooperation is challenging but necessary at all levels of governance. This section considers the practice, potential and challenges for inter-sectoral cooperation at multiple levels of governance: community-based/village, decentralised and national level, and lake-wide and basin.

At the village and decentralised government levels, cooperation between sectors takes place to an extent through development planning and budgeting processes and through cross-cutting committees, as they relate to planning and environmental management. However, there remains much scope for further cooperation and coordination. At the local, community-based level, cooperation between committees or groups associated with different government sectors (fisheries, water, local government, forestry, for example) may take place informally, but is not necessarily formally encouraged or required. Such groups include environmental management committees, water user associations and savings and credit groups, as well as BMUs, with membership coming from the communities themselves. Although there may be cooperation between these structures based on personal relationships and/or informal coordination by decentralised government, because of the prevalence of separate reporting and support relationships associated with different government sectors, and lack of coordination and cooperation at national levels, such cooperation is likely to be limited and not as effective as it could be.

There is also some degree of cooperation and collaborative working in fisheries enforcement, which brings together several sectors and institutions, including the judiciary, local government, the police, BMUs and central government. These institutions are required to work together with each playing their assigned roles. However, individual interests in these institutions have led to a lack of integration, coordination and cooperation. For instance, BMUs are required to report illegal fishing practice to the District Fisheries Officer who is then required to liaise with the prosecutor at the police department to charge the illegal fisher in a court of law. The magistrate should then decide on the case in relation to the evidence presented. In practice, however, BMUs rarely report illegal fishers because they may be reluctant to see their community members jailed or fined. In addition, BMUs have become discouraged by the practices of corrupt fisheries officers and police officers who take bribes in exchange for confiscated gears or for the continuation of illegal fishing, with the charge being never presented in court. Local politicians have, at times, discouraged enforcement by BMUs and fisheries officers, not wanting to upset their potential voters, particularly during election periods.

At national level in the three countries bordering the lake, there is limited coordination and cooperation between departments/ministries. Ministries of water, environment and fisheries, for example, may collaborate in relation to certain activities and donor-supported projects, but do not have formal arrangements to enable cooperation.

Inter-sectoral cooperation at the lake-wide and basin level is encouraged through the Lake Victoria Basin Commission (LVBC), formed by the EAC in 2001. The LVBC is tasked with the harmonization of policies and laws within the EAC member countries in relation to environmental management, which should be in support of economic development and

poverty reduction. Their remit is therefore wide-ranging. Although both the LVBC and LVFO are institutions of the EAC, there are no formal linking arrangements between them. Whilst the LVFO is made up of the fisheries departments/ministries, the LVBC is linked to the national ministries of water, environment or natural resources. The activities of the LVBC are largely driven by externally supported projects, such as the World Bank funded LVEMP. The first phase of LVEMP took place between 1997 and 2005 and the second phase between 2009 and 2017, with support from the Global Environment Facility and Government of Sweden, as well as the World Bank. The aim of LVEMPII is to improve the collaborative management of transboundary natural resources and management of pollution and environmental degradation hotspots in the basin. Although fisheries are part of the LVBC remit, and a number of projects and activities are funded by LVEMP, coordination and cooperation is limited by lack of a formalised relationship between the LVBC and LVFO and lack of coordination of plans and budgets at the national level.

An example of cooperation around the lake, but beyond fisheries, is the Lake Victoria Region Local Authorities Cooperation (LVRLAC), which is an organisation that brings together local authorities around the lake to promote environmental management and social development. The organisation is active in providing a space for cooperation between local authorities though this is, to an extent, limited by funding secured from external sources.

6. Moving Towards Inter-Sectoral Cooperation

Key areas where cooperation could also be encouraged are through:

1) Greater coordination of the formation of, and support for, community-based structures between government sectors so that there is less demand on community members and a more holistic approach taken.
2) Decentralised government planning and budgeting processes, involving multiple sectors and taking an inter-sectoral perspective.
3) More formalised structures could be created, such as working groups, to encourage cooperation between sectors at the national level of government in line with the framework of the Comprehensive Africa Agriculture Development Programme (CAADP).
4) Greater cooperation between lake-wide and basin structures such as the LVFO, LVBC and LVRLAC.

The fisheries of Lake Victoria are strongly affected by activities, policies and plans in many other sectors, yet there is little evidence of formal inter-sectoral cooperation and coordination. Where and when cooperation and coordination does take place, it is supported by projects and is for a specific purpose and may be short-term. Awareness of inter-sectoral linkages amongst stakeholders is apparent through initiatives such as the LVEMP I and II, the creation of LVBC, and the yet to be operationalized at the lake level, Comprehensive Africa Agriculture Development Programme (CAADP). The latter is a declaration by Heads of African states and governments on accelerated agricultural growth and transformation for shared

prosperity and improved livelihoods, in which fisheries are recognised (African Union 2014). However the geographical scale of Lake Victoria and the diversity of sectors and actors impacting on Lake Victoria make inter-sectoral governance a significant challenge. Inadequate resourcing to government sectors and non-government actors contributes to there being limited collaboration and cooperation, with much inter-sectoral cooperation being dependent on project funding. Greater communication and identification of common goals and objectives may assist in developing more coherent governance in the absence of resources to secure strong inter-sectoral governance.

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CHAPTER 5

A Tale of Two Cities: Similar Ecologies and Diverging Governance of Urban Fisheries in Kolkata and Colombo

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Abstract In complex social-ecological systems, patterns of utilization of ecosystem services are a key factor that shapes both the society and the broader ecosystem. This paper investigates the links between urban environmental governance and fisheries in the urban wetlands of Kolkata (India) and Colombo (Sri Lanka). We argue that, despite the similar development of formal policy and institutions in both cases, the comparative success of the Kolkata fishery is mainly due to three factors: 1) diverse-ecosystem use, 2) urban ecological symbiosis, and 3) strong community collective action. We conclude that successful governance of the environment and ecosystem uses such as fisheries will depend on collective action and informal institutions as much as the formal means of governance. We call for further research on urban governance systems that can foster diversity in land-use and harmonized utilization of ecosystem services and livelihoods for building resilient urban communities in the globalizing cities of the Global South.

1. Introduction

In cities undergoing globalization, urban governance is shaped more by global political-economic trends than by local resource limitations (Marcuse and Kempen 2004). However, globalizing cities are also situated social-ecological systems characterised by a complex web of interactions amongst "human" and "non-human" components (Swyngedouw 1996; Robbins 2007; Heynan 2014). In these systems, patterns of utilization of ecosystem services are a key factor that shape not only society but also the broader ecosystem itself. Thus, changes to the historical patterns of ecosystem use – such as in fisheries – may trigger social-ecological dynamics that cannot be readily controlled within the realm of governance alone.

This paper investigates the links between urban environmental governance and ecosystem uses, such as fisheries, in the emerging cities of the Global South. We do so through a comparative case-study of fisheries in the urban wetlands of Colombo (Sri Lanka) and Kolkata (India). In pre-colonial times, wetlands around Colombo and Kolkata had similar

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ecologies and sustained similar ecosystem uses such as artisanal freshwater fisheries (Ghosh and Sen 1987; CEA 1994). However, the political and economic changes of colonial and post-colonial periods have not only engendered different governance systems related to wetlands and fisheries in the two cities, but have also produced very different ecosystem utilization patterns and ecological characteristics (Ghosh 2005; Smardon 2009; Hettiarachchi et al. 2012). While traditional subsistence freshwater capture fisheries disappeared gradually in both wetlands, a community-based wastewater fed pond fishery industry emerged in Kolkata in the late Colonial period which thrived through the Post-colonial period. Conversely in Colombo, despite the soaring prices of seafood, wetland fisheries were relegated to a part-time and quasi-legal industry. In this study we ask, 1) was this divergence in the two fishery systems caused by the trajectories of formal policy and institutional change? 2) if not, what other factors caused this divergence? 3) are there lessons to be learnt from the success and failures of the two cases that can be generalized for the emerging cities of the Global South?

In this paper, we understand governance to be both formal and informal and characterized by "diverse and networked policy-making and implementation arrangements over time and scale, diverse institutional actors and policy instruments, and both self-organized and centrally-steered choreography of actors" (Morrison 2014, p. 103). These governance actors and arrangements sit within a broader political environment which can be both sympathetic and unsympathetic to fisher communities (Morrison 2007). By studying formal policy changes and broader institutional changes over time, it is possible to draw lessons about the multiscale conditions which produce these arrangements and their outcomes.

First, we chronologically present the policy and institutional changes related to wetland and fisheries governance and their outcomes in the two cases. Second, we analyse the broader political, economic, social and ecological causes and consequences of transformations in the fisheries and synthesise the key factors for the relative success of the Kolkata wastewater fishery against the Colombo case. In conclusion we discuss the broader lessons from the two cases that can be generalized for urban environmental governance in the emerging cities of the Global South.

We argue that, despite the similarities in the historical trajectories of formal policy and institutional changes in both cities, the relative success of the Kolkata fishery compared to Colombo, was mainly due to three factors: 1) diverse-ecosystem use, 2) urban ecological symbiosis, and 3) strong community collective action. We conclude that successful governance of environment and ecosystem system uses such as fisheries in emerging cities of the Global South will depend on the ability to grasp the full complexities of their hybrid rural-urban landscapes and relationships between ecology and ecosystem uses, whereas community collective action and informal institutions will be as important as formal means of governance. We conclude by calling for further research on urban governance systems that can foster diversity in land-use, and utilization of ecosystem services and livelihoods, to build resilient urban communities in the globalizing cities of the Global South.

2. Methods

The city of Colombo (Sri Lanka) and the city of Kolkata (India) were selected as the two main case studies for this study for the following reasons (Figure 5.1). Colombo and Kolkata are major urban centres in South Asia, which are rapidly growing both in terms of population and economy. The region is expected to hold more that 35% of the world's urban population by 2025. Both cities are globalizing through service-oriented industries, and have experienced rapid foreign capital inflows into their respective urban real-estate markets. There are also major urban wetland systems used for freshwater fishing within the metropolitan areas of both Colombo and Kolkata.

The wetlands of Colombo and Kolkata face similar environmental pressures to other urban wetlands in fast expanding cities in South Asia and other developing regions. Both cities have a history of more than a century of wetland alteration, and currently face some severe social consequences of wetland loss and degradation. Therefore, Colombo and Kolkata are two critical and representative cases (Flyvbjerg 2006) for studying urban fisheries governance in emerging cities of the Global South. Both cases also have continuous historical records of wetland management from colonial times, and fairly consistent scientific data on ecological and hydrological characteristics of the wetlands.

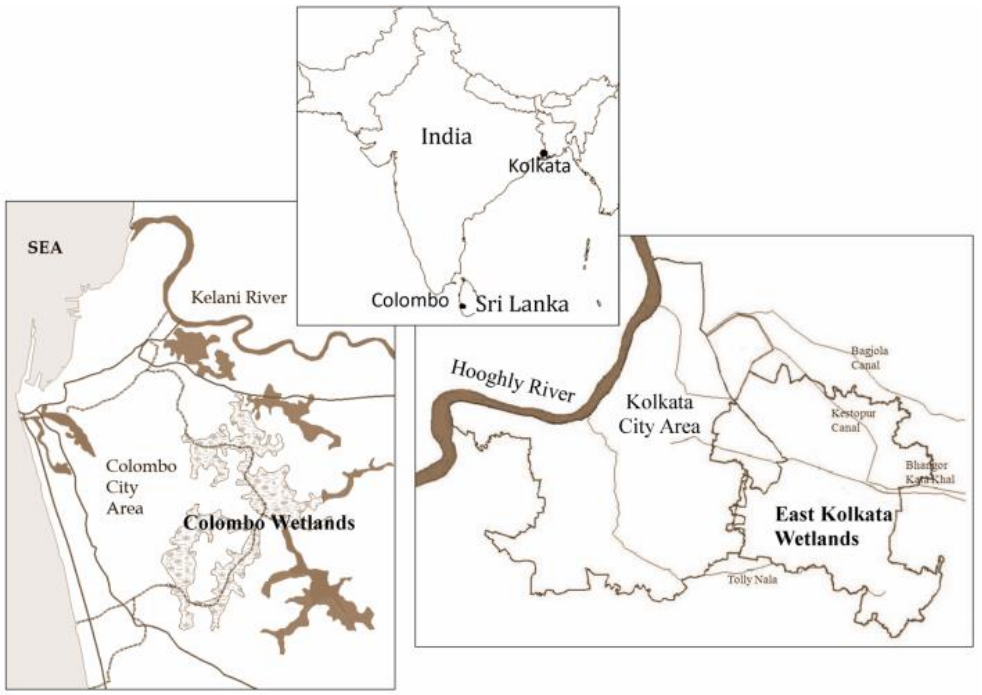

Figure 5.1. Map of study areas.

The study was undertaken between 2010 and 2013 and involved key informant interviews, document analysis, field observations, ecological surveys, participant observation, and a review of the scientific literature. Thirty-three key informants (eleven in Kolkata and twenty-two in Colombo) were interviewed during the period 2010-2012 and interviewees included officials from the state agencies, local politicians, environmental activists, experts, and community leaders. Document analysis involved archival search at the National Library of Sri

Lanka, East Kolkata Wetlands Management Authority and content analysis of the most popular English Weekly of Sri Lanka between 1978 and 2010 (www.sundaytimes.lk). Community and decision-maker focus group discussions were also conducted in both cities. The Colombo case also involved additional ecological surveys to fill information gaps.

3. Results and Discussion

3.1. Ecological histories of the Colombo and Kolkata wetlands

3.1.1. Kolkata wetlands

The East Kolkata Wetlands are a vast network (12,500 ha) of ponds, marshes, and paddy lands located to the east of the Kolkata city in the Upper Gangetic Delta (Figure 5.1), which is hydraulically connected to the Bay of Bengal (Ghosh and Sen 1987). The wetlands were traditionally used for low-yield winter rice cultivation and brackish water fishing by the numerous peasant communities. In the late 1800s under colonial rule, combined stormwater and sewage from expanding Kolkata was channelled into the wetlands, causing irreversible pollution and silting. Facing this ecological threat, local peasant communities adopted a skilful use of sewage as a water and nutrient source for pisciculture and agriculture (Ghosh 2005). From the 1920s, the wetlands were transformed from a brackish tropical marsh to vast network of freshwater ponds and agricultural fields (see Photo 5.1). By 2010, the wetlands were receiving 0.7-1.0 million m^3 of wastewater from the city per day and produced 16,000 t of rice, 30,000-50,000 t of vegetable, and 8000 t of fish per annum (Kundu 2010). This protected the downstream ecosystems of the Ganges Delta from Kolkata's massive pollution loads (Saha 2011). Today, the wetland also provides broader ecosystem services of carbon sequestration, and recreation valued as 53 million and 43 million Indian rupees per year respectively (Sarkar 2002).

Photo 5.1. A traditional guard hut in a community owned fishpond in the eastern Kolkata wetlands.

However, rapid urbanization is putting immense pressure on this ecosystem (Hettiarachchi et al. 2015). The wetland area shrunk by 20% due to direct conversion between 1945 and 2003, with an exponential rise of unaccounted conversion of wetlands (and fishery ponds) for real-estate purposes since the mid-1990s (Ghosh 2005; Kundu 2010). Water quality has deteriorated and silt influx to the wetland system has increased with this recent conversion trend (Saha 2011). 15.2% of the fish pond extent has been rendered unusable due to excessive siltation (Kundu 2010). Invasive fish species such as *Clarius gariepinus* and *Pangasius sutchi* are spreading in the wetland system. These environmental pressures are threatening the overall sustainability of the fishery system and the wetland ecosystem.

3.1.2. Colombo wetlands

The wetlands around the city of Colombo are a network (about 1,000 ha) of freshwater marshes, open waterways, estuaries, and paddy land scattered across metropolitan Colombo (Figure 5.1). The larger wetland area was traditionally used for rain-fed rice cultivation, capture fisheries, animal husbandry, and canal-based transport. Fishing was carried out both in the freshwater canals within the marshes and paddy land and in the estuarine areas towards the coast. The estuarine fishing was bigger in scale. The 1928 Colombo Flood Protection Plan changed the wetlands dramatically, resulting in both ecological and hydrological fragmentation (Hettiarachchi et al. 2012). Drainage and flood control functions became the primary use of the wetland as the city expanded, and the importance of all other ecosystem services waned by the early 1980s. Large swathes of paddy land became unsuitable for cultivation, and the fishing which was dependent on the same paddy cultivation system also deteriorated rapidly. While estuarine fishing by fulltime fishermen continued, it was at a much smaller scale.

From the early 1980s this ecosystem came under intense urbanization pressure. Investigating the central portion of the Colombo wetlands, Hettiarachchi et al. (2014) estimated that about 60% of the paddy lands were converted to built-up areas between 1981 and 2008 (see Photo 5.2), and 44% of the native grass-dominated marsh areas were transformed into a habitat dominated by shrubs and small trees such as *Annona glabra*, along with a rapid proliferation of invasive plants and fish. Today, this degradation is further threatening the wetland fishery which is already in rapid decline.

In summary, both wetlands underwent tremendous ecological transformation during the colonial period, with the most acute wetland degradation and loss of ecosystem services seen in the last three decades. However, despite these transformations, the Eastern Kolkata wetlands still largely retains wetlands characteristics, whereas the Colombo wetlands have transformed from marshes to shrub wetlands, which are increasingly losing wetland characteristics. Although a bifurcation of the ecological histories of the wetlands is clearly visible, it remains to be understood what changes in urban governance caused this divergence.

Photo 5.2. A wetland area being reclaimed using solid waste in Colombo.

3.2. Historical changes in urban governance and the fisheries industries in the two cities

Both Kolkata and Colombo have under gone complex political, economic, institutional changes during the study period (see Table 5.1 and Figure 5.2).

Urban development: Key urban development institutions emerged in two major fluxes; the first in the late Colonial period (1930-40s) and the second after the pro-capital economic restructuring of the mid 1980s and early 1990s (Shaw 2007; Hettiarachchi et al. 2015). Powerful urban development agencies emerged in both cities during the late post-Colonial period, such as the Colombo District Low Land Reclamation Board and Urban Development Authority in Colombo and Kolkata Metropolitan Development Authority in Kolkata. These organizations were strengthened through a series of amendment acts during and after the 1980s which allowed them to take over the wetlands with little resistance.

Land reform and fisheries: Both cases witnessed the strengthening of formal institutions of land-reform and fisheries cooperatives in the post-Colonial period. Large number of fisheries cooperatives were functioning in Kolkata even before the Cooperatives Act and the Inland Fisheries Act were introduced, and these formal institutions strengthened the legal position of the cooperatives. The land-reform act also provided legal protection for collectively held fish ponds. Conversely, despite similar cooperative and land-reform acts in Colombo, there was no evidence of wetland or estuarine fishermen collectivising in the Colombo Wetland area.

Environment: Formal environmental institutions emerged in both cases during the mid-1970s, closely shadowing global environmental treaties and initiatives. In both cases the Ramsar Convention had a clear influence on the wetland protection institutions that emerged from the late 1990s onwards. The East Kolkata Wetlands Management Act in Kolkata and the

National Wetlands Management Policy were driven by Ramsar principles. However these institutions and the organizations they mandated had no legal or operational connection with the wetland communities, which drastically undermined their practical ability to protect the wetlands and their uses (Ghosh 2005; Hettiarachchi et al. 2015).

Table 5.1. Chronology of formal policy and governance changes related to urban development, urban environmental management and fisheries in the two cases.

Kolkata	Colombo
Urban development and flood control	
The West Bengal Slum Areas (Improvement and Clearance) Act (1972); The West Bengal Town and Country (Planning and Development) Act, (1979); The Kolkata Municipal Corporation Act (1980); Jawaharlal Nehru National Urban Renewal Mission – Over View (2005)	Colombo Flood Protection Plan (1937); Colombo District Lowland Reclamation and Development Board Act (1968); Urban Development Authority Act and amendments (1978); Colombo Master Plan (1978); Metro Colombo Development Plan (2010)
Environmental management and wetland conservation	
Water (Prevention & Control of Pollution) Act, (1974); Environmental Protection Act –India (2004); East Kolkata Wetlands Management Act (2006); National Wetland Rules – India (2010)	National Environmental Act and amendments (1980, 1988, 2000); Coast Conservation Act and amendments (1982, 1988); National Wetlands Policy and Strategies (2005)
Land reform and Inland fisheries	
Land Reforms Act – West Bengal (1956); Cooperatives Act and Rules–West Bengal (1978); Inland Fisheries Act – West Bengal (1984);	Paddyland Act (1958); Cooperative Societies Act (1972); National Aquaculture Development Authority Act (1998);

Real-estate and investment: Following the pro-capital economic restructuring in India and Sri Lanka during the 1980s (Kalegama 2004; Nagaraj 2006) both wetland systems came under intense urbanization pressure stimulated by speculative real-estate investment. As Hettiarachchi et al. (2015) demonstrate, the flow of international finance capital into the real estate sector in both cities put pressure on the city administrations to "open the wetlands for business". A similar scenario in Kolakata is described by Drubajyothi Ghosh (Sarkar 2016) as "wetlands are real estate in waiting". Photo 5.3 and 5.4 show how prime real-estate is taking over wetlands in Kolkata and Colombo. "Urban development" agencies in both cities facilitated this take-over, using not only their political clout, but also the legal mandate carefully crafted for this purpose.

The formal policy trajectories of the two cases are similar in many ways. However as many modern governance scholars claim, formal policy declarations or institutional change only play a partial and often less significant role in most complex governance systems (Bevir 2012; Morrison 2014). As Figure 5.2 illustrates there are many broad parallels in the political-economic history of the two cases as well. Therefore, it has to be understood what political-

economic idiosyncrasies, and other social and ecological factors caused the divergence of fishery and wetland governance in the two cases despite the many similarities.

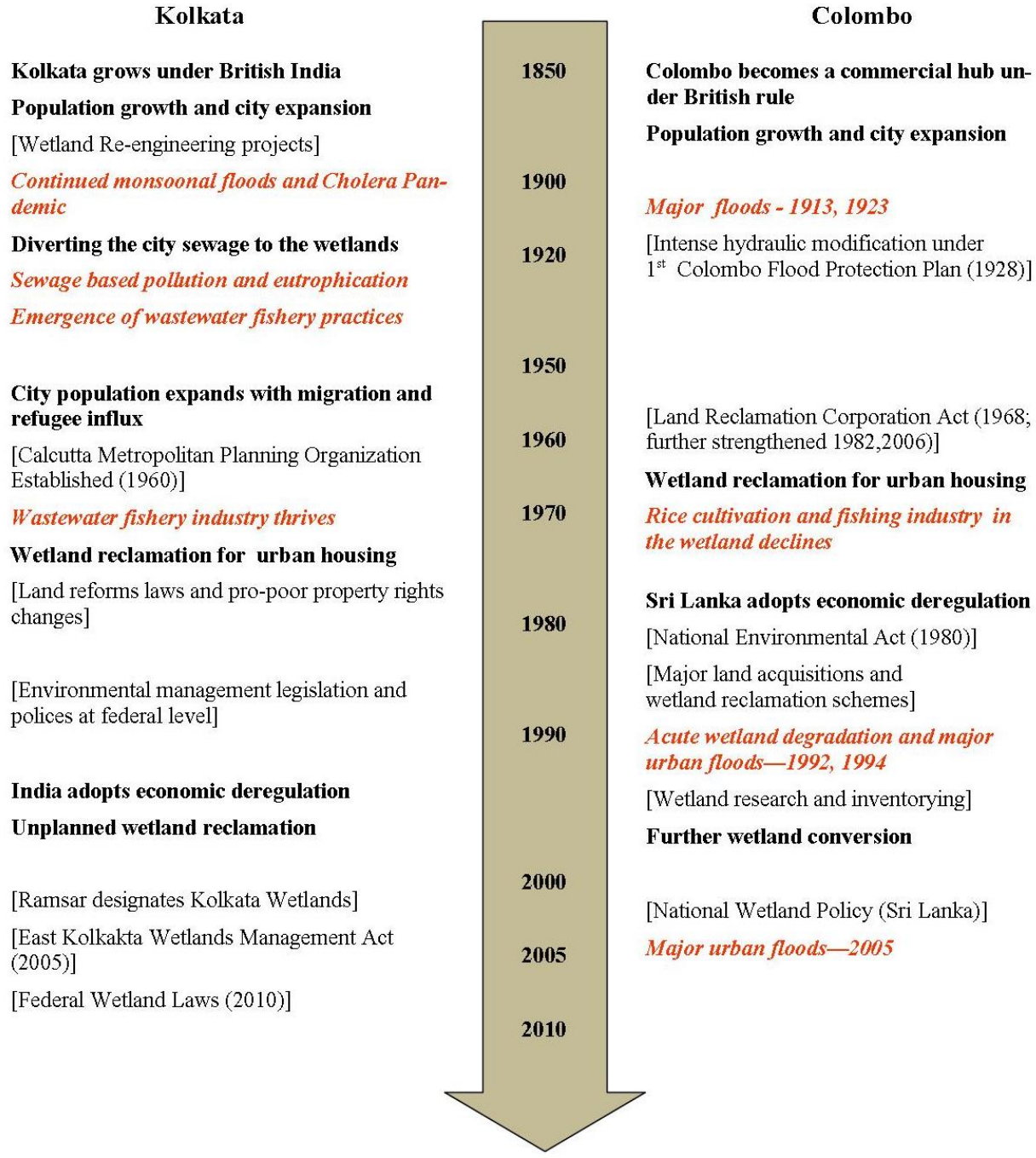

Figure 5.2. Key political-economic and formal policy changes and related social-ecological outcomes. Formal policy changes are given with square brackets, political and economic changes are given in bold face, and social-ecological outcomes are in red italics.

Photo 5.3. A community owned fishpond in Kolkata with the booming salt-lake city IT zone in background.

Photo 5.4. Freshwater marsh turned into a recreational reservoir and prime real-estate in Colombo.

4. Synthesis

4.1. What strengthened the wastewater fisheries in Kolkata?

Our results show that both the Colombo and Kolkata wetlands had similar fishery systems in the Colonial times where numerous interconnected communities depended on mixed fishing and farming livelihoods. The turning point of the divergence between the two fishery systems occurred when the Kolkata wetland and its fishery communities faced an existential threat due to sewage based pollution. It is reasonable to assume that Kolkata wetland communities were historically more dependent on fishing than farming and due to the distance from the

sea the city itself provided a stable market for freshwater and brackish-water fish. Therefore, the emergence of a wastewater fishery in Kolkata transformed what were scattered feudal fishery practices into an organized commercial aquaculture industry. In addition to retaining most of the wetland fish varieties, the new system also introduced new productive fish varieties to the local fish market.

Because the wastewater fishery system replaced the need for a mechanized wastewater treatment plant for Kolkata it was welcomed and facilitated by a certain section of the city's bureaucracy during the late Colonial and post-Colonial times. A small but significant fraction of the bureaucrats understood the connection of fishing to the wetland ecology and how the city and the wastewater fishery were two ecosystems in symbiotic relationship (Ghosh and Sen 1987). They lobbied vociferously for the conservation of this fishery system amid the city's rapid expansion from the early 1990s.

However, the foremost factor that ensured the survival of the wastewater fishery system was the organized fisher community, who had transformed from peasant fisher folk into an urban working class. From the initial feudal (landlord based) property rights scheme, fishery ponds were rapidly taken over by capitalist private ventures or fisher cooperatives. Even under the private pond owners, fishermen were organized as a working class and unionized. The land-reform laws and Cooperatives Act of early 1970, brought under mounting public pressure, were seized by the cooperatives to consolidate their position over private owners and in some cases forcibly take over un-operational private ponds and resume production.

The Kolkata fishery system thus forged a self-consolidating triangle of: 1) diverse-ecosystem use, 2) urban ecological symbiosis, and 3) strong community collective action. First, "diverse ecosystem uses" ensured the continuation of what Ghosh (2005) defined as 'keystone' ecosystem uses (e.g., fishing, wetland cultivations), which had been essential processes of the human dominated wetland ecosystem for centuries. Second, "urban ecological symbiosis", where the fishery system functions as a receptor of wastewater from the city (on which it is entirely dependent for nutrient needs) and in turn produced a large proportion of the city's fish requirement. Third, "community collective action" provided the social and political base for the continuation of this system, especially in the nationalist welfare-state policy environment of the post-colonial period.

4.2. Causes and consequences of the collapse of the fishery industry in the Colombo wetlands

Conversely in the Colombo wetlands, the fishery system remained scattered. Fishermen mostly operated individually, while the fishing grounds remained as commons. With the advancement of technology and facilities for seagoing fishermen, more sea fish entered the market, which undermined the competitiveness of the stagnant wetland fishing industry. On the one hand, the popularity of native wetland fish varieties were overshadowed by the common availability of sea fish, and on the other, pollution, habitat change and invasive fish have dwindled the native fish stock (Hettiarachchi et al. 2014).

Apart from a few full time fishermen in the estuarine areas in the southern periphery of the Colombo wetlands, wetland fishing has entirely vanished or has become a part-time occupation that caters to cheap eateries or illegal clients such as moonshine bars.

Disappearance of the 'keystone' ecosystem uses such as fishing, has removed the essential management practices that maintained the wetland under human dominance. This along with intense hydraulic modification has caused an overall ecological transformation of the wetland. Wetland farmers and fishermen who were not organized as a working class like in Kolkata had no political wherewithal to counter the attack on their livelihoods through hydraulic modification and wetland reclamation schemes, and had no option other than to seek alternate livelihoods in the city.

Although the city administrations (from the colonial time to present) saw the need to maintain part of the wetlands for flood control purposes (a form of urban symbiosis) they failed to make the connection between diverse wetland uses such as fishing and paddy cultivation and the health of the wetland. Their narrow planning regime, which considered the wetlands as an inert piece of infrastructure in the flood control system, not only destroyed the community uses such as fishing, but also eventually reduced its flood retention capacity.

5. Conclusion

Our analysis demonstrates that trajectories of formal policy and institutional change in urban governance in Kolkata and Colombo had many similarities. The political-economic histories of the two cases had many parallels, but also significant differences. The actual developments in the wetlands fisheries were also mediated by some factors beyond the control of formal policy. Three key factors made the Kolkata wastewater fishery comparatively more resilient than the wetland fishery in Colombo. First, the symbiotic relationship between the city and wastewater fishery made the wetland an important part of the urban ecology. Second, the continuation of diverse wetland use sustained the basic wetland ecological processes. Third, the collective nature of the Kolkata fisher communities and various informal institutions within the fishery system allowed them to organize against the attacks of capital on their livelihoods.

Kolkata's example provides some important lessons for governing the urban environment and ecosystem uses such as fishing in the emerging cites of the Global South. First, it empirically confirms theoretical assertions on the importance of facilitating rural-urban mixed land-use and economic regimes within emerging urban agglomerates (Ghosh 2005; Yokohari et al. 2008). This encourages diverse ecosystem use. In Kolkata's case, having a wetland wastewater fishery system within provided the city with multiple benefits for wastewater management and food security. Such mixed land-use regimes and diverse ecosystem uses can also help sustain other ecosystem services such as flood retention, carbon sequestration and aesthetic services, as we have witnessed in Kolkata.

The comparative resilience of Kolkata's wastewater fishery system and the failure of the fishery in the Colombo wetlands also remind us that certain industries like small-scale fisheries are inextricably bound with the rights of communities to land, livelihoods and ecosystem services. The sustainability of such industries can be ensured only by protecting those rights through strong collective action supported by both formal and informal

institutions. Those who envision urban resilience should identify such strong community practices and informal social institutions that form a backbone; such as the fisher cooperative system of East Kolkata Wetlands. They should strive to integrate them into urban governance and planning at all scales. Strengthening the scientific knowledge, technical capacity, and political clout of these communities is essential to this process.

Both the Colombo and Kolkata wetland fishery systems are under unprecedented threat due to the expansion of speculative real-estate investments. As the Colombo case illustrates, failing to protect community driven ecosystem based industries like wetland fisheries in the emerging cities from the pressures of capital, will not only cause a social injustice for those communities but also will have far reaching economic, social and environmental consequences that will endanger the wellbeing of a much larger urban population. We conclude by calling for further research on urban governance systems that can foster diversity in land-use and utilization of ecosystem services and livelihoods, in order to build resilient urban communities in the urbanizing cities of the Global South.

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CHAPTER 6

Competing Claims in a Multipurpose Lake: Mapping Resource Conflicts on Lake Kariba

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Abstract Lake Kariba is a transboundary artificial water body originally constructed for the generation of hydro-electric power. It is now a multi-purpose resource that supports economic activities such as commercial fishing, artisanal fishing, aquaculture, tourism and water transport. These economic activities have given rise to intra-sectoral and inter-sectoral resource-use conflicts. This paper discusses these conflicts. The paper also recommends possible interventions which can be employed to enhance stakeholder dialogue and conflict resolution.

1. Introduction

Lake Kariba is an artificial impoundment in Southern Africa on the Zambezi River (Figure 6.1). The lake is a transboundary resource that is shared between Zambia and Zimbabwe. Kariba dam (Photo 6.1) was built during the Federation of Rhodesia and Nyasaland between 1955 and 1959, to provide hydro-electric power to Northern Rhodesia (Zambia) and Southern Rhodesia (Zimbabwe).

According to Coche (1971), the Federal Hydro-Electric Board was constituted to oversee the construction of the Kariba dam. In 1956, the Federal Power Board was created to replace the Federal Hydro-Electric Board. The mandate of the new Board was the generation and distribution of electricity within the Federation. In 1964, the Federal Power Board was replaced by the Central African Power Corporation (CAPCOR). CARPCOR was later replaced by the Zambezi River Authority (ZRA).

The lake has a total surface area of 5 500 km^2 at capacity, a maximum width of 40km, a mean width of 19.4km, a maximum depth of 120 metres, a mean depth of 29.2 metres and a shoreline length of 2 164km (Kenmuir 1983).

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Over the years, multiple users have emerged. These include the inshore small-scale gill-net fishers, offshore commercial fishers who are referred to as Kapenta operators, hoteliers, houseboat operators, recreational fishers and fish farmers. The term "Kapenta" is the local name for the Tanganyika sardine (*Limnothrissa miodon*).

During the pre-impoundment period, the riparian Tonga communities engaged in fishing activities on a subsistence basis to complement subsistence farming and hunting (Zambezi Valley Consultants 2001, p. 6). Scudder (2005, p. 9) also noted that prior to the construction of the Kariba Dam, information on fish populations was based mainly on the indigenous knowledge of the local Tonga, who knew most of the species by name and caught them using a variety of fishing gears including baskets, traps, spears and poisons. Due to the depth and flow rate of the primary channel of the Zambezi River, fishing was restricted to the river's edge, floodplains and tributaries (Scudder 2005, p. 9).

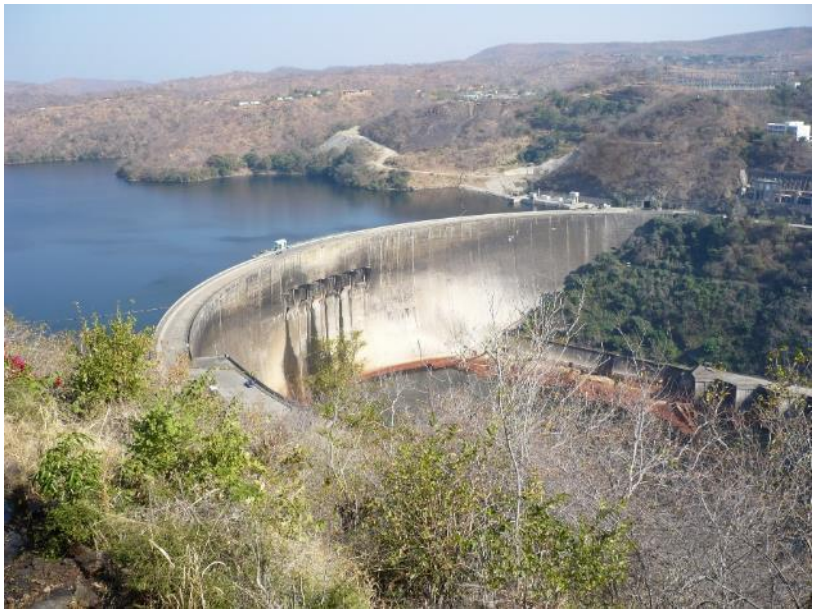

Photo 6.1. Kariba Dam wall (Photo by W. Mhlanga).

After the creation of the Kariba Dam, the shoreline on the Zimbabwean side was divided into different fishing concessions which fell into two main categories: (a) areas given to European Concessionaires, and (b) areas given to traditional chiefs from among the displaced Tonga people (Zambezi Valley Consultants 2001, p. 6). Consequently, the pre-impoundment traditional fishing practices and fisheries management were replaced by the introduction of a fisheries management system based on central government control in both countries. This system also introduced new fishing gears (gill-nets), and made the traditional pre-inundation fishing gears illegal.

The two major fisheries sectors on Lake Kariba are the capture fishery and the aquaculture sector. The capture fishery can be further sub-divided into three sub-sectors. These sub-sectors are the pelagic/offshore fishery (also referred to as the kapenta fishery), the artisanal/inshore fishery (also referred to as the gill-net fishery) and the recreational fishery (also referred to as the rod and line fishery). The pelagic fishery is a single species fishery that is based on the introduced freshwater Tanganyika sardine, *Limnothrissa miodon.*

The artisanal fishery is based on several inshore species including the exotic Nile Tilapia (*Oreochromis niloticus*). The recreational fishery also exploits the inshore fish species, including the indigenous Tigerfish (*Hydrocynus vittatus*).

In the artisanal fishery, there are several commercially important fish species which are usually exploited by the artisanal fishers. On the Zambian side of Lake Kariba, the bulk of the artisanal fish catches was composed of *O. niloticus* (54.48%), Hydrocyon (14.80%) and Mormyridae (11.40%) (Mbewe et al. 2011a). On the Zimbabwean side of the Lake, the important fish species in the artisanal fishery are the Cichlids (*Oreochromis mortimeri, Oreochromis niloticus, Sargochromis codringtonii, and Tilapia rendalli);* the Cyprinid (*Labeo altivelis);* the Characid (*Hydrocynus vittatus);* the Mormyrids (*Mormyrus longirostris, Mormyrops anguilloides)*; and the Clariid (*Clarius gariepinus)* (Mhlanga, *personal observation*).

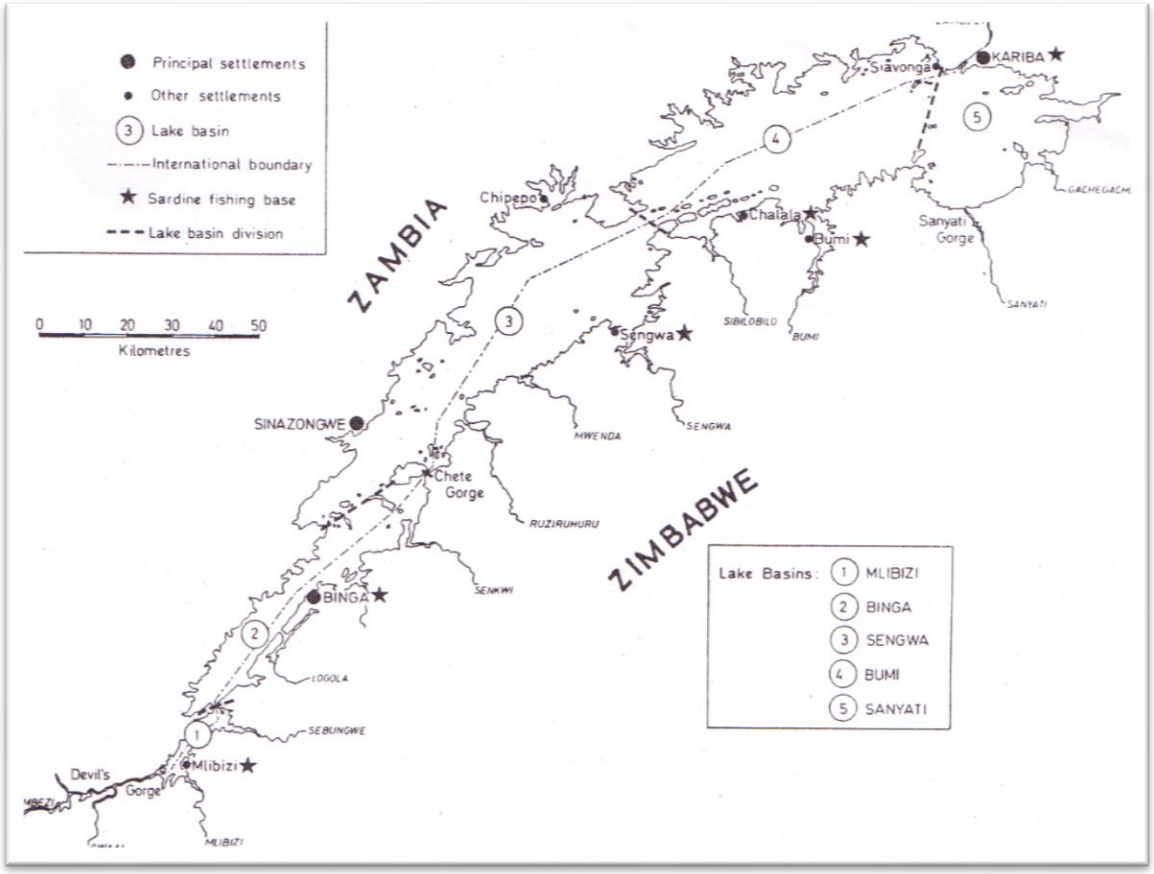

Figure 6.1. Map of Lake Kariba showing the hydrological basins.

2. Social Aspects of the Artisanal Fishery

In both Zambia and Zimbabwe, the artisanal fishers are based in fishing villages/camps which are spread along the shoreline. In Zimbabwe, all the fishing villages/camps are permanent, while in Zambia, most fishing villages are permanent, but there are a few temporary fishing camps. In Zimbabwe, there are a total of 41 fishing villages (Zimbabwe Lake Kariba Frame

Survey Report 2011) while in Zambia there were a total of 65 fishing villages, 63 of which were permanent, while 2 were temporary (Mbewe et al. 2011b). The total number of licenced fishers on the Zimbabwean side in 2011 was 1 154 (Zimbabwe Lake Kariba Frame Survey Report, 2011) while in Zambia there were 4 653 fishers in the same year (Mbewe et al. 2011b).

3. Governance Arrangements of the Fishery Resource

Governance of the artisanal fishery on Lake Kariba happens at two levels; the national and the bilateral level. The governance arrangements are best described in terms of the institutional arrangements for fisheries management. In Zambia, the Department of Fisheries (DoF) is responsible for the fisheries resources on the Lake, while in Zimbabwe, it is Lake Kariba Fisheries Research Institute (LKFRI), which falls under the Zimbabwe Parks and Wildlife Management Authority (ZPWMA).

At the bilateral level, the governments of Zambia and Zimbabwe signed a Protocol on the Management of the Shared Fisheries Resources on Lake Kariba and the Transboundary Waters of the Zambezi River (Mhlanga and Mhlanga 2014). The Protocol, which was signed in 1999, paved the way for the establishment of the Joint Fisheries Management Committee (JFMC), which is the policy and decision making body, and the Joint Fisheries Technical Committee (JFTC), which is the management and research body. It should be noted that while this Protocol has created a platform for dealing with fisheries related matters, (including intra-sectoral conflicts) there is still no single platform for dealing with inter-sectoral matters (including inter-sectoral conflicts).

In the Kapenta fishery (Photo 6.2), entry is regulated through a permit system in both Zambia and Zimbabwe. Kapenta fishing permits are issued by the Department of Fisheries (DoF) in Zambia and the Zimbabwe Parks and Wildlife Management Authority in Zimbabwe. Each fishing vessel, locally referred to as a "Fishing Rig" should be registered and an annual permit fee paid to the respective regulatory institutions. In Zimbabwe, the minimum mesh size on the lift net is 8 mm (millimetres). In the artisanal (gill-net) fishery, entry is also through a licensing system in both countries. Each gill-net fisher must have a fishing licence and only gill-nets are allowed. The minimum stretched mesh size of the gill-nets is 76 mm in Zambia and 102 mm in Zimbabwe. In Zimbabwe, gill-net fishing is prohibited in the waters that are adjacent to state-protected wildlife areas (National Parks and Safari Areas).

Enforcement of the permit system is much easier in the kapenta fishery compared to the gill-net fishery. This is because in the kapenta fishery fishing vessels are larger and fewer than in the artisanal fishery and the kapenta fishing boats fish at night using lights (including an underwater light as a Fish Aggregating Device) which make them highly detectible.

4. Issues and Solutions

4.1. Intra-sectoral conflicts

4.1.1. Artisanal fishers versus pelagic fishers (Zimbabwe)

The artisanal fishers conflict with the pelagic (kapenta) fishers mainly with respect to fishing grounds. Conflicts may arise when the artisanal fishers set their nets further offshore where there may be conflict with the pelagic fishers who encroach into the artisanal fishers' fishing grounds. Conversely, conflict may also arise when the pelagic fishers go to fish in the littoral zones (which are designated as kapenta breeding grounds and where kapenta fishing is not allowed).

Photo 6.2. Kapenta rig (Photo by W. Mhlanga).

Historically, the conflict between gillnet and kapenta fishers was often viewed as a racial conflict between the gillnet fishers (who are black) and the kapenta fishers (who were predominantly white). The Zimbabwean government embarked on a kapenta permit redistribution exercise in the early 2000s which was aimed at addressing the racial imbalances. This was a black empowerment exercise which was conducted at the time of the Fast-Track Land reform programme. Currently, more than 80% of the kapenta permits are owned by blacks, but conflicts still exist between kapenta fishers and gill-net fishers.

There is supposed to be no conflict between the artisanal gill net fishers and commercial Kapenta operators largely because Kapenta operators exploit the pelagic offshore resource, while gill net fishermen are limited to the inshore fishery. However, there are cases when Kapenta fishermen catch fish that could have been caught by gill net fishermen, though where this happens, it would be by mistake rather than by intent.

Gill net fishermen complain that Kapenta fishing crew sometimes steal their nets at night and sell them to illegal fishers. Complaints of this nature lack proof and are quite few. Kapenta operators complained that gill net fishermen provide an illegal market for Kapenta. The operators alleged that gill-netters buy Kapenta from their crew manning the rig at night. Once bought, Kapenta is mostly dried in illicit places and then sold at a give-away price. The practice reduces the catch landed by the Kapenta operators and also floods the local market thus forcing operators to sell their Kapenta below breakeven point.

4.1.2. Artisanal fishers versus fishery managers (Zimbabwe)

Artisanal fishers have often clashed with fishery managers, especially on the Zimbabwean side. This is mainly due to the fact that the Fishery law-enforcement division falls within the Zimbabwe Parks and Wildlife Management Authority (ZPWMA). The ZPWMA is responsible for law-enforcement of both the terrestrial and aquatic natural resources. Thus fishers have sometimes been apprehended for using gill-nets with mesh sizes that are less than 4-inches (102mm), which is the stipulated (legal) minimum mesh size (on the Zimbabwean side). The fishers have sometimes also clashed with the fishery managers when they have been apprehended for fishing in non-fishing (prohibited) zones.

Gill net fishers think some fisheries management regulations imposed on them are unrealistic and managers do not take into consideration their real problems and needs. On the other hand, managers think that fishers are irresponsible people who do not care about the sustainability of the resource. Compliance with regulations is poor. Fishers consider the regulations to be complex, difficult to understand and against their interests.

Among all the regulations imposed on the fishery, fishermen are compliant only with those regulations they perceive as helping in sustaining the resource. Otherwise most of the regulations are being infringed upon because fishermen are less enthusiastic to follow regulations, which place them at a comparative disadvantage. To avoid arrest, they have established networks with sympathizers to forewarn each other of the presence of law enforcers.

The recently announced requirement to fish between 06:00 and 18:00 hours is one such regulation that fishers are finding difficult to understand its rationale. Gill net fishers always prefer fishing at night when it is cooler. This is particularly important given that Kariba can be very hot. They also argue that if one leaves nets in water during the night chances are high that the following morning you will find your catch eaten up by red-claw crayfish (*Cherax quadricarinatus*) and crocodiles (*Crocodylus niloticus*). Since the introduction of the exotic red-claw crayfish into Lake Kariba is fairly recent, studies are still under way to determine its diet in the lake and this will confirm whether the crayfish is indeed consuming fish as asserted by the fishers.

Some fishers, particularly in the Mlibizi and Binga Basin (Basin 1 and 2 in Figure 6.1), fail to understand the rationale of setting the minimum mesh size at 4 inches (102mm), when their Zambian counterparts whom they share the fishing ground with are permitted to use 3 inch (76mm) but may sometimes be using as small as 2 inch (51mm) nets. In these basins, convincing fishers that they should co-manage the fishery is difficult. Zimbabwean fishers do not perceive the claims that sustainable benefits will accrue to the community as likely. Restraint on the exploitation today in the interest of having more tomorrow will result in gains that will be totally dissipated by their Zambian counterparts. Fishers therefore believe that individual restraint today cannot be capitalized in individual gain tomorrow.

Zimbabwean fishers argue that if they use 4 inch (102mm) nets, they catch less fish than their Zambian counterparts who use 3 inch (76mm) mesh-sized nets or less. They argue that the species composition nowadays is such that the most important species escape through the four-inch nets. Most species that are found in abundance, like the Imberi (*Brycinus imberi*) and silver fish (*Schilbe intermedius*) would indeed escape through four-inch nets.

Gill net fishers have alleged favoritism in the manner in which law enforcement agents sanction them for violating fisheries management regulations. Sanctions and penalties for violating some of the regulations are not standardized across the gill net fisheries and Kapenta operations. For example, if a gill net fisher is found fishing in a closed (prohibited) area, his gear is confiscated and his boat sunk. This is not the case when a Kapenta operator is caught fishing in closed areas. In most of these cases he is fined but retains his gear, once the fine for an impounded vessel has been paid.

Licensed fishers are aware that there are many people residing upstream along major rivers such as the Sanyati River who are exploiting the riverine fishery without licenses and use all types of gear and fishing methods. These unofficial fishers are believed to catch a lot of fish. Licensed fishers complain that much effort is wasted in policing the licensed fishers while many other people fish illegally and go unnoticed (Nyikahadzoi 1998).

4.1.3. Zimbabwean gill net fishers versus Zambian gill net fishers (international)

The fishery resources on the Zimbabwean side are categorised into either fishing zones (where artisanal fishing is allowed) and non-fishing zones (where artisanal fishing is not allowed). Consequently, this zonation, coupled with the minimum mesh size rule of 4-inches (102mm), is generally believed by the fishers to have given rise to better fishing on the Zimbabwean side compared to the Zambian side. The Zimbabwean fishers, especially in the Western section of the Lake (Binga/Mlibizi) have conflicts with their counterparts from Zambia as they report that some of the Zambian artisanal fishers come to fish on the Zimbabwean side. These fishers, especially those in the Binga/Mlibizi area feel that this problem has escalated so much that it is now negatively affecting the sale of their fish.

4.1.4. Gill net fishers versus aquaculture (Zimbabwe and Zambia)

Cage culture is the major type of fish farming on Lake Kariba. Conflicts between artisanal fishers and the commercial cage culture are mainly due to the issue of space. The fish cages, and their buffer zones, are located in prime artisanal fishing grounds. Consequently, the artisanal fishers are of the view that the cage farming operations have resulted in a reduction of their fishing grounds. However, a positive development is that some of the fishers now report catching large sized fish which are mainly Nile Tilapia (*Oreochromis niloticus*) (Photo 6.3). The artisanal fishers attribute this to the introduction of cage farming (Photo 6.4) which is a monoculture enterprise based on the Nile Tilapia, *O. niloticus*. The Nile Tilapia is an exotic species which grows much faster than the indigenous Kariba Bream (*Oreochromis mortimeri*). Thus, genetically, the Nile Tilapia grows to a larger size in a shorter period than the *O. mortimeri*. In areas near the fish cages, the artisanal fishers further attribute the fast growth to increased availability of food from the cages.

4.2. Inter-sectoral conflicts

4.2.1. Artisanal fishers versus houseboats (Zimbabwe)

Major tourist attractions on Lake Kariba include the luxury boats referred to locally as Houseboats (Photo 6.5). These are large boats that have sleeping and cooking facilities and

can accommodate more than 6 passengers. These houseboats are popular with holiday-makers who want to enjoy the wilderness experience particularly along the sections of the shoreline that are in the areas designated as wildlife protected areas (National Parks and Safari Areas) on the Zimbabwean side.

Photo 6.3. Artisanal fisher with Nile Tilapia (*Oreochromis niloticus*) (Photo by W. Mhlanga).

Photo 6.4. Fish cage – commercial cage culture production (Photo by W. Mhlanga).

When the boats are moored on the shoreline, the artisanal fishers may pass near these boats as they go either to set their gill-nets or to collect their fish catch. The holiday-makers sometimes feel that the presence of the artisanal fishers is an intrusion that disrupts their wilderness experience. The artisanal fishers on the other hand, also feel that these houseboats may at times disrupt their fishing activities, especially the movement of smaller boats (tender boats) that are used to go on game-viewing or rod and line fishing outings. The propellers on these tender boats may damage the artisanal fishers' gill-nets.

4.2.2. Artisanal fishers versus Lodge Owners/Hoteliers (Zimbabwe)

There are several lodges and hotels along the Lake Kariba shoreline. Artisanal fishers may sometimes clash with these Lodge owners and Hoteliers. These Lodge owners and Hoteliers sometimes feel that the presence of the artisanal fishers on their lake frontage may disrupt their visitors' holiday experience. For the artisanal fishers, the boats from the lodges/hotels may sometimes damage their gill-nets.

Photo 6.5. Houseboats in harbour (Photo by W. Mhlanga).

4.2.3. Artisanal fishers versus protected area managers (wildlife managers) (Zimbabwe)

The Zimbabwean side of the lake has several National Parks and Wildlife Areas. Conflicts arise as the wildlife managers sometimes view the artisanal gill-net fishing camps/villages as "springboards" for wildlife poachers. For example, there have been reported incidences where poachers, especially those targeting black rhino (*Diceros bicornis*) and elephant (*Loxodonta africana*) (Photo 6.6), had come into the wildlife protected areas through the fishing camps. The wildlife managers, on the other hand, have sometimes been accused of heavy-handedness when they were reported to have either confiscated or destroyed artisanal fishers' boats which would have been found in waters that are not open to gill-net fishing.

4.3. Inter-sectoral collaboration structures

The inter-sectoral collaboration structures at the national level are not formalised. At the international/bilateral level, inter-sectoral collaboration is limited primarily to the Zambia/Zimbabwe Joint Permanent Commission (JPC). However, this commission deals mainly with defence and security matters.

Within the fisheries sector, at the national level in Zimbabwe, there are no formal institutions that provide a framework for dialogue between the fisheries managers, policy makers and the resource users. Some structures that include the Sub-Area Fishers

Association (SAFA), District Fishers Association (DIFA) provide a framework for dealing with issues related to the artisanal fishery. While efforts are being made to strengthen these institutions, two major issues to consider will be (a) the formalisation of these structures, and (b) developing a mechanism that will ensure the long-term sustainability of these structures.

Photo 6.6. Elephants on the shoreline (Photo by W. Mhlanga).

In Zambia, the Village Management Committees, Zonal Management Committees, the Lake Kariba Inter-Zonal Fisheries Management Association provide a platform for addressing artisanal fishery issues.

At the bilateral level, there is a formal mechanism that was set up by both parties to address fisheries management issues between Zambia and Zimbabwe. The major vehicle for this collaboration is the Protocol on the Management and Development of the Fisheries on Lake Kariba and the Transboundary Waters of the Zambezi River. This Protocol was signed in November 1999. Within the framework of the protocol, there is a Fisheries Management Committee and a Fisheries Technical Committee. The composition of these committees is made up of representatives from both Zambia and Zimbabwe. This Protocol can be considered as intra-sectoral collaboration, since it focuses primarily on fisheries-related matters.

The report of the Fifth Technical Consultation on Development and Management of the Fisheries of Lake Kariba (FAO 2012, p. 27) states that "while formal Technical Committee meetings as spelt out under the Protocol had not taken place, the five FAO technical consultations had provided the forum for discussion and agreement on technical issues of management and development of the fisheries of Lake Kariba, as envisaged under the Protocol." Consequently, a major limitation to the implementation of the Protocol has been financial. Given the importance of the fishery sector in both countries, there is need for advocacy to ensure that the two governments prioritise the implementation of the protocol by providing the requisite funds for the Committees.

5. Discussion

The conflict between artisanal (gill-net) fishers and pelagic/commercial (Kapenta) fishers are not a permanent feature but arise from time to time. Consequently, constant dialogue between these two groups can assist in effectively resolving these conflicts.

The conflicts between the artisanal fishers and the fishery managers are complex and varied. These conflicts, which vary from issues related to fishing regulations, or to the perceived heavy-handedness of the fishery managers by the fishers, cannot be resolved overnight but require a concerted long-term effort to build a mutual interaction between the managers and the resource-users. This will require regular consultations between the two groups.

In resolving these conflicts, special attention should be paid to the conflicts in Basin 1 and Basin 2 (Mlibizi and Binga Basin). This area requires a different approach to resolving the conflicts here when compared to the rest of the lake. This is because there is constant interaction between the Zimbabwean and Zambian fishers. The resolution of the conflicts in this part of the lake requires the direct collaboration between the fishery managers on the Zambian side with those on the Zimbabwean side. These managers need to come up with a common position in addressing the fishers' concerns.

The conflict between the gill-net fishers and the commercial cage aquaculture operations is not easy to solve since these two activities are mutually exclusive. Once fish cages are established on the lake, they take up the area that hitherto had been part of the fishing grounds of the artisanal fishers. This effectively reduces the fishing grounds for the artisanal fishers. While the introduction of fish cages has reduced the fishing grounds for the artisanal fishers, some artisanal fishers in Basin 5 (Sanyati Basin) are of the view that the introduction of the Nile Tilapia cage farming has resulted in larger-sized fish such that they are now using the larger mesh-size nets. The introduction of small-scale aquaculture among the artisanal fishers, may be one option to try and offset the reduction of their traditional fishing grounds due to commercial cage aquaculture.

Recreational fishers usually clash with artisanal fishers on the issue of gill-net damage due to boat propellers. A major cause of this is that usually the gill-nets are usually not easily visible to other lake users because there are no buoys attached to the gill-nets. If artisanal fishers were to mark their nets with highly visible buoys, this would go a long way in minimising these conflicts. However, most of the gill-net fishers cannot afford to purchase the commercial buoys due to the low fish catches which bring in very limited income.

Lodge owners/hoteliers and the artisanal fishers have to accommodate each other in their activities given that the lake is a multi-purpose resource. A major challenge between these two user-groups is the limited dialogue. Therefore, there should be constant dialogue so as to address any conflicts that may arise.

For Protected Areas Managers, the conflict with the artisanal fishers can also be minimised through dialogue. In order to address the polarisation that now exists between the wildlife managers and the artisanal fishers, there is need for the wildlife managers to discuss with the fishers how best the fishers can also assist in addressing the issue of wildlife poaching.

Inter-sectoral collaboration is currently very limited. Consequently, concerted efforts must be made to strengthen it. The success of this inter-sectoral collaboration will depend partly on the stakeholders who are on the ground (within the Lake Kariba environment), and also partly on the central governments (through the line Ministries) to endorse this collaboration and provide the requisite funding to kick-start the convening of the consultative meetings. Thereafter, the forum would have to come up with a financing mechanism for all non-government members.

6. Conclusion

At the national level, there is a need for the creation of a multi-stakeholder consultative forum that meets to discuss issues of common interest (inter-sectoral). The composition of the multi-stakeholder forum would cover regulatory authorities, resource-users and other key interested parties. The regulatory authorities would include those in the sectors of energy (including Zambezi River Authority), water resources, environment, fisheries, wildlife, tourism, transport (Lake Navigation/Safety), Police, Customs and Immigration as well as the riparian local authorities (both Urban and Rural). The resource users would also be drawn from the sectors listed under the regulatory authorities. Other interested stakeholders would include Non-Governmental Organisations (NGOs) that are implementing projects and programmes within the Lake Kariba environment.

At the international level, there is a need for the two governments to facilitate innovative mechanisms to mobilise financial resources for both the Joint Fisheries Management Committee and the Joint Fisheries Technical Committee to meet regularly. While the Joint Fisheries Technical Committee has been able to meet and discuss fisheries related issues through the platform of the Technical Consultations Meetings on the Development and Management of the Fisheries and Aquaculture of Lake Kariba, the two riparian countries should set aside funding for these meetings. These consultative meetings are currently being funded by the FAO Sub-regional Office for Southern Africa.

The Technical Consultations Meetings have served as a useful platform to carry out the work of the Joint Fisheries Technical Committee. However, these noble efforts can be enhanced further if the Joint Fisheries Management Committee can meet regularly so as to make policy decisions as well as to assist in the implementation of the recommendations made by the Joint Fisheries Technical Committee.

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CHAPTER 7

Cultural Strengths and Governance Challenges of a Northern Inland Fishery

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Abstract This chapter studies strengths and challenges of the Finnish commercial inland fisheries. Their lake fisheries are characterized by abundance of watersheds and long cultural traditions in fish consumption and gear development. They are also related to the local owner-based management system within the entire fisheries governance regime. Other key issues are livelihood support, recreational fisheries and protection measures regarding fish stocks and the Saimaa ringed seal. Many small-scale fishers face problems with acquiring fishing rights for sufficiently wide water areas and struggle from the increased impact of nature conservation measures. Opportunities for the future of the fishing livelihood are based on growing importance of local food movement and healthy fish products as well as the cultural appreciation of the environmentally-friendly and locally-ingrained fishing practices. The chapter concludes that the potential of the studied inland fisheries has not been fully realized. The intermediary level of fisheries governance system is able to mediate between wider interests and local realities, but the core challenge is how to cross sectoral borders towards achieving inter-sectoral collaboration.

1. Introduction

Commercial inland fisheries in Finland have deep historical roots. In the past, settlements have typically been established nearby the thousands of lakes, which provided necessary subsistence and routes for transportation. The rich inland fishing culture of today is based on multiple fishing practices and the tradition of consuming inland fish species. The material benefits and the recreation standpoints of fishing have slowly separated from each other (Lappalainen 1998). Presently diverse groups of commercial and recreational fishers form a continuum from most professional ones to specialized sport fishers. The household fishers, who combine recreation and subsistence benefit motivations by using passive methods like gill nets and wire traps, are located in the middle range of the continuum.

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Along with transformations in society, the fisheries' interaction with other user and interest groups has increased. Besides recreational interests, especially the strengthened emphases on environmental conservation have started to reform the Finnish inland fishery from within and through confrontations related to sustainability of fishing activities. Inside the fisheries, pertinent paradigmatic tensions connected with a water-owner based decision-making system still hamper development of the commercial inland fishing.

This chapter studies strengths and challenges of the Finnish commercial inland fisheries by presenting the main conflicts and synergies in the system. We also outline suggestions for achieving inter-sectoral collaboration. Results and insights are based on published literature and authors´ long-time experiences in fisheries research and administration.

2. Background

Commercial inland fisheries were split off from self-sustaining agriculture in the beginning of the 20th century and became a supplementary source of income, in particular for small-scale farmers. Seasonality of profitable fishing activities contributes to pluriactive strategies, the various combinations of income sources. Full-time commercial fishing in Finnish inland waters is a relatively recent phenomenon, dating 1960s and 1970s. Rapid increase of trawling has resulted in increased turnover and capitalization. However, compared internationally, even the most professional entrepreneurs can be labelled as small-scale fishers (SSFs). They are self-employed, own their fishing equipment and harvest nearby waters with relatively small boats.

Structural changes that the Finnish society and the fishing industry went through during the 1980s and 1990s reduced the number of inland fishers (Sipponen et al. 1999). However, official statistics (Luke 2016) have underestimated the total number of commercial inland fishers to be about 400, as a substantial proportion of part-time fishers has been lacking in the fisher register. This situation changed in the beginning of 2016: all who sell fish are now obliged to sign up for the register. Consequently the number of registered inland commercial fishers more than doubled to 849 (Penttinen 2016). About 3% of the fishers are women. Total commercial catch was 6 million kilograms, while recreational fishers caught over 23 million kg in 2014 (Luke 2016). During 2014 nearly 1.6 million people were estimated to have fished, representing approximately 30% of the entire Finnish population; participation rate is slightly increasing after many years of decreasing fisher numbers (Luke 2016).

Lakes cover 34,000 km^2, nearly 10% of Finland´s total surface area, and constitute a significant part of country´s national treasures. Of all countries in Europe, this proportion is the highest in Finland. Lakes are covered by ice for 4-5 months in Southern Finland and 6-7 months in Northern Finland enabling both commercial and recreational ice fishing. Although commercial inland fisheries are concentrated in 67 single lakes covering 44% of inland waters, the actual area harvested commercially is 26% of the total (Sipponen et al. 2006). The most important lakes are located in the eastern and northern parts of Finland (Figure 7.1).

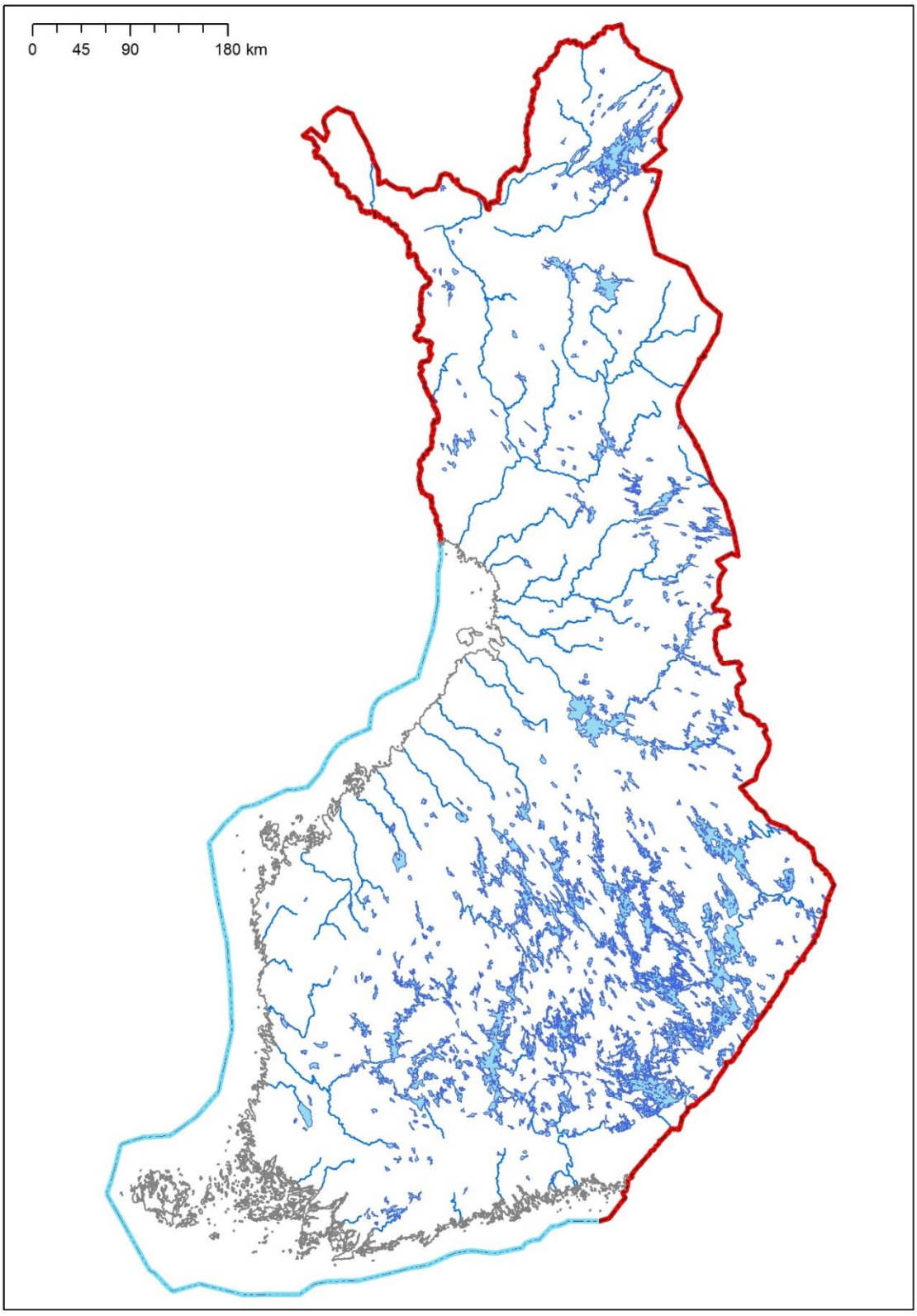

Figure 7.1. Map of Finland showing inland waterbodies (including lakes) and land- and water-based international boundaries.

Although open sea fishers in the Baltic Sea harvest the major proportion of landings in Finland, 96% of the Finnish commercial fishers are either coastal or inland SSF operators

(Salmi and Mellanoura 2016). Commercial inland fisheries are largely dependent on the steady demand for vendace (*Coregonus albula*), appreciated especially in the eastern and northern parts of the country. Strong and unpredictable fluctuations of vendace stocks amplify variations in the annual fishing income, in spite of the fact that fish prices tend to increase when the stocks are sparse. The inland vendace fisheries are of primary importance to the entirety of Finnish SSF, including that along the Baltic coast (Salmi and Mellanoura 2016).

In addition to small-scale pair-trawling, the inland vendace fisheries are operated using seine nets on ice and in the open water, typically by collaboration between two or three fishers or within family members (Photo 7.1, 7.2, 7.3, 7.4, 7.5). The vitality of fishing culture is embodied in seine netting on the ice, which is a traditional adaptation to the northern climate (Pennanen 1986) and still performed via modern motorized versions. Technological development has reduced the need for man power. Besides the vendace fisheries, bottom gill nets for pikeperch and perch are important fishing methods. In the world's northernmost large reservoirs in Lapland, small-scale fishers use gill nets for whitefish.

Photo 7.1. Vendace catch on ice.

The main administrative body is the Ministry of Agriculture and Forestry, and three regional fisheries authorities (ELY-Centres) operate under its auspices. The local fisheries management system is based on joint possession of private waters, a peculiar Finnish feature. While the

decision making is mostly collective, the water lots are in private ownership, which is connected to owning land enclosing the waterbody. Water owners are represented by statutory fishery associations (SFAs, N = 10,500) for areas held in common by a registered village. Due to fragmentation and small size of the water areas in private ownership, SFAs have joined together to form geographically much larger Fisheries Regions (FRs) management units to enforce co-operation. In the whole country, there are 225 FRs, 80% of which operate in freshwaters. In addition to owners, both recreational and commercial fishers' organizations are members of this body. Both SFAs and FRs are mandated by law and are responsible for arranging fishing and fisheries management. While most of the inland waters are privately owned, the state-owned public waters in larger lakes are important for some of the professional lake fishers. Since the beginning of 2016, these public water areas are managed by The National Board of Forestry. Catch quotas based on the common fisheries policy of the European Union are not dispensed in inland waters.

Institutions, in particular legislation and property rights, play an essential role in Finnish inland fisheries. Ownership and boundaries of waters are often complicated, which has contributed to the complexity of the Fisheries Act, especially concerning the administration of fisheries in private waters. During the past 50 years, Finnish fisheries legislation - concerning both commercial and recreational fishing - has encompassed three major phases of renewal, each of which has entailed diverging underlying philosophy. Legislation originating from 1952 was based on protection of fish stocks, while the Act of 1982 stated that maximum sustainable productivity should be obtained from fishing. A new paradigm of the present Act – in force since the beginning of 2016 – highlights ecologically, economically and socially sustainable utilization of fish stocks as well as knowledge-based management. The latter has been regarded as one of the most important new elements contributing to balanced decisions as far as endangered fish species are concerned. The new legislation has also intensified control and regulation, such as national fish size limits and compulsory registration of inland commercial fishers.

Photo 7.2. Winter seining.

Photo 7.3. Winter seining.

Photo 7.4. Winter seining.

Photo 7.5. Vendace trawling.

3. Issues and Solutions

3.1. Complex power relations in vendace fisheries

At the local level, the amount and type of fishing allowed is largely regulated by SFAs, which rarely possess strong economic incentives to support commercial access. The owners have typically been interested in enhancing fish stocks by stocking fingerlings. After long-lasting battles over fishing rights, the recreational rod fishers and their lobby groups have been able to bypass the water owner based license system: the current fisheries legislation allows use of most rod methods either as an 'every man's right' or after paying a nation-wide fishing fee. Since 1997 the fishing fee system has enabled rod fishers to fish in privately owned waters irrespective of owners' will. Commercial fishers, however, have failed to gather enough political power to break free from their dependency on water owners.

Fishing rights have raised local contradictions within the Finnish inland fisheries system for long. For instance in the early 1990s, conflicts arose regarding the fishing rights of commercial vendace fisheries using small pair trawls and seine netting (Salmi and Auvinen 1998). The SFAs refused to grant permits for commercial fishing, because the vendace stocks were declining. The local owner-fishers, who used mostly gill nets, regarded commercial fishing practices as unsustainable for the reproduction of vendace stocks. The fisheries legislation at that time, however, stressed that local water owners should allow commercial fishing operations when fish stocks are not endangered. When involved in judicial processes, fisheries scientists have generally argued that commercial fishing does not endanger the future of vendace stocks, concluding that the fluctuations on vendace stocks were mostly due to natural causes – contrary to the view of water owners. In addition to disagreements of knowledge, the contradictions were fuelled by the local water owners' will to fortify their power position and fishing opportunities (Salmi and Auvinen 1998).

Battles over access rights have turned up also recently, but instead of suspected over-fishing of vendace stocks, the SFAs' banning of trawl fishing has been motivated by excessive by-catch of *salmonid* fish species. This by-catch is, however, small in comparison to the catch of recreational fishing, and most of the commercially captured under-sized salmon and trout individuals are released alive. In resonance with the growing emphases on protecting the *salmonid* fish in the lakes, also the most vocal recreational fishers have started to criticize commercial fishing activities as unsustainable. Furthermore, the local conflicts are sometimes affected by SFA's unsuitable administrative practices. According to outdated legislation, a SFA should determine either in its rules or in its annual meeting so called gear unit value, which is a figure contributing to the comparison of fishing effectiveness between different types of gear. Gear unit is also a measure to allocate fishing rights between owners within a SFA. The highest gear unit value was usually given to trawl and by giving high values a SFA could in practise prohibit trawling in its water areas. Other ways that aimed to restrict trawling included neglecting the duty to set gear unit values in particular for trawl, or forbidding it because of the presupposed damage to vendace stocks, as was the case in Finnish Lake District area some years ago. As a result of this kind of approach a commercial fisher was suspected to have fished illegally and practised overfishing. The Court of Appeal judged that a

SFA has to determine the gear value (for trawling), and that the ban of trawling requires that its harmfulness to fish stocks must be shown. Consequently, as gear value for trawl had not been ascertained, the Court of Appeal could not determine whether a fisher had exceeded his fishing rights – and the fisher was exonerated.

Appropriate communication and collaboration between different players has been considered a key factor facilitating successful fisheries management (Kooiman and Bavinck 2005), and of particular importance in multi-level governance systems like the one observed in Finnish lake fisheries. Unfortunately, lack of adequate respect and trust towards other partners has undermined several projects aimed at improving the prerequisites for carrying on commercial fishers' profession. The most recent approach to improving allocation of fishing licenses is a negotiating process, where all relevant partners (water owners, commercial fishers, regional fisheries advisors, researchers, regional fisheries authorities) would make their operation rules based on mutual understanding and utilize long-term knowledge of fish stocks (vendace) in decision-making. So far participants of the pilot project have regarded this kind of training useful as it has increased their understanding of the managerial process, but the final test – reaching synergies in a real-life situation – awaits.

As the European Fisheries Funds have focused more on open sea and coastal fisheries, practical measures to improve the position of commercial inland fishing entrepreneurs have been scarce. A core problem has been that with funding of the renewal of fishing fleet being prohibited, young fishers have been largely excluded from the purchase of a first boat. Only minor investments have been granted, such as substituting new boat motors for old ones and acquiring snow mobiles and quad cars for ice-fishing. However, funds have been successfully allocated to improve the basic infrastructure such as fishing harbour facilities and improving the quality of catch in major lakes.

3.2. The increased impact of nature conservation

For more than 100 years, fishing opportunities in Finnish rivers and lakes have suffered from water-related construction. Before harnessing most of the northern rivers for hydroelectric power production and timber transportation, river fisheries were important for local subsistence. Particularly in Northern Finland fingerlings of salmon, sea trout and whitefish have been stocked in order to compensate for the damages of these stocks. These stockings, however, turned out to be clearly undersized (Marttila et al. 2014). If compensation levels could be reassessed in favour of fish stocks, ecological conditions and fishing opportunities would simultaneously be improved.

Although contradictions between nature conservation and fisheries interests may in some cases occur regarding the protection of fish species, the Finnish commercial inland fisheries seldom targets the endangered *salmonid* fish species. The more frequent problem relates to the unintended catches of an endangered and protected seal species in Eastern Finland by commercial and recreational fishing. In the Saimaa lake system, for instance, the use of certain fishing gear types has been regulated since 1999 in order to protect the Saimaa ringed seal *(Pusa hispida saimensis)* from inadvertently drowning in fishing gear. New pressures for the regulation, highlighted by the seal conservationists and researchers, arose

in 2006 and 2007 along with a declining trend in the seal population. As a consequence, the system of total closures of spring-time gill net and trap net fishing was initiated. Most of these closures were based on contracts between local shareholder (water owner) associations and the fisheries authorities (Salmi et al. 2013, Ratamäki and Salmi 2015).

About 60 commercial fishers are located in the habitat of the Saimaa ringed seal, 30 of which operate more professionally. Besides participating in the vendace fisheries, half of the professional fishers use gill nets. The seasonal closures of gill net fishing limit the commercial fishers' opportunities for harvesting pike-perch, which could become an increasingly important income source in periods of scarce vendace stocks (Salmi et al. 2011). In addition, the restrictions have an even bigger effect on the abundant groups of recreational fishers. More than 400 000 recreational fishers operate in the living area of the Saimaa ringed seal, many of which use gill nets (Salmi et al. 2013). In this case, the rules of fishing restrictions have been applied without considerable separation between professional and recreational fishers. The lack of consideration of the livelihood aspects for commercial operators vis-à-vis the leisure aspect of recreational fishers in rule making reflects the weak power position of the Finnish commercial lake fisheries, despite the fact that most professional entrepreneurs (i.e. commercial fishers) have been entitled for partial financial compensations due to the restrictions.

In addition to the interrelations between commercial and recreational fisher groups and water owners, the Saimaa ringed seal case is an example of inter-sectoral contradictions between utilization of natural resources and environmental protection. The engagement of the local water owners in the making of spring-time fishing closures has prevented open confrontation, but still the conflict can be characterized as a cultural one, reflecting difficulties of fruitful communication due to differing life worlds and values. The interviewed commercial fishers in the Saimaa region feel that the seal protectors' comments in the media slandering the fishing livelihood are often based on insufficient and distorted knowledge (Salmi et al. 2011).

3.3. Opportunities based on local food movement

Notwithstanding the contradictions, commercial inland fisheries can be regarded as an environmental friendly mode of food production. The climate change impact of locally harvested fish is typically smaller than the imported high volume fish products, and especially when compared with meat production (Silvenius et al. 2015). In open water the haul is drawn without any contact with bottom, unwanted fish species can be and are released, and the summarized fuel consumption is low. In spite of its motorization, winter seining on ice is probably even more environment-friendly than most other fishing methods.

Only 6% of Finnish fish consumption originates from the domestic capture fisheries (Suomen Kalakauppiasliitto 2015). The idea, promoted by international NGOs, e.g. WWF, of substituting globally produced food with locally capture fisheries products is favourable for inland fisheries. The inland fish in particular is clean and healthy as food and contributes to individual well-being. In spite of these advantages, and successful examples of supplying local

lake fish products in markets and grocery shops, the full potential inherent in fish and fisheries still awaits blooming.

Local cooperation between fishers, researchers and technical experts creates an important platform for reaching synergies and practical context-dependent innovations. Common activity has been gear development, e.g. seal-proof trap net technology, in order to mitigate conflicts concerning the conservation of the Saimaa ringed seal populations (Photo 7.6). One future option for raising the public awareness of SSF products – and revitalizing the SSF – is labelling or 'branding' the local fish stocks. For instance, in Northern Finland the well-known small-sized vendace stocks in Lake Kitka and the famous vendace stocks in Lake Puruvesi have been granted Protected Designation of Origin and Protected Geographical Indication by the EU. In Lake Puruvesi seven commercial fishers and a fish processor have formed an enterprise for processing and distributing their winter and summer seine net catch.

Photo 7.6. A fisher testing a new trap net technology for preventing seal bycatch.

4. Discussion

In spite of the challenges, commercial inland fishers have shown astonishing spirit. Contrary to earlier forecasts, they are slightly more abundant than a decade ago. The fishing livelihood enhances vitality of remote rural communities and is of the utmost importance for domestic inland fish supply for wholesale and retail market. Commercial fishers employ means to adapt into a changing operational environment to secure their livelihood. The continuance is enabled by fast technological development and fishers' appreciation of specific life mode with freedom and work in the nature. The most professional fishers are active also in contributing to fisheries policy. Governance system should take the increased diversity of fisher groups into account. This applies, for instance, the operational opportunities of pluriactive fishers.

The ideas stressing environmental conservation have become increasingly weighty in the society and started to mould policies also in the fisheries sector. Thus dealing with the issues at hand in Finnish inland fisheries requires moving out from sector-specific perspectives towards inter-sectoral governance. This step has been taken in the new 2016 fisheries legislation, which provides two forums for collaboration. A new innovation is a regional committee consisting of water owners, environmental authorities, regional council and commercial and recreational fishers. This committee does not have the power to make decisions, but it will provide initiatives and recommendations for regional authorities. The first task of the new regional committee is to make a proposition of the new geographical structure for FRs management units during 2016. The power to set up managerial regulations that earlier were delegated to FRs have been retrieved to regional authorities, but the FRs still hold an important role as a synergetic stakeholder organization for reconciling likely conflicts in advance and set an avenue for development of commercial fisheries. Similar expectations can be set for the new regional committees in wider geographical and participatory settings.

The water-owner-based system of decision making generates extensive stakeholder involvement and a local knowledge base for the purpose of fisheries management, which would be very difficult to reach by a top-down regime. From the commercial fishers' perspective, however, this system has challenges due to SFAs' license policies, which do not always appropriately consider the needs of fishing enterprises. This may be partly because of poor knowledge and suspicions about the sustainability of commercial fishing methods and activities. Preceded by a passionate debate in the Parliament, 2016 Fisheries Act allows fisheries authorities to grant access for commercial fishers to privately owned waters, if owners finally fail to allow the access. In addition, the state-owned lake areas provide commercial fishers with fishing licenses to facilitate engagement of start-up enterprises and use of the most effective fishing technology.

5. Conclusion

The studied northern small-scale inland fishery is firmly based on traditional fishing culture, although commercial operators are not greatly numbered. Appreciation for freshwater fish and a good state of fish stocks and water environment provide a favourable setting for a culturally, economically, socially and ecologically sustainable utilization of the natural resources. We conclude, however, that the potential has not been fully realized: the Finnish inland fisheries system awaits the emergence of blue revolution. Finnish inland fish resources are still largely underutilized in terms of catch volume or variety of potential touristic services.

The challenges are mainly related to knowledge, attitudes and governance practices, affected by new interests, values and increased complexity. The multi-level structure of the present Finnish fisheries decision-making system fits as such well to these challenges, as the intermediary level is able to mediate between wider interests and local realities. The core challenge is how to cross sectoral borders towards inter-sectoral collaboration. Still more

communication and collaboration are needed to enhance the understanding of everyday problems, societal benefits and prospects of commercial inland fisheries among the public, and at the various levels of the governance system itself.

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CHAPTER 8

Inter-Sectoral Fisheries Governance Issues and Solutions on the Cauvery River, India

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Abstract Home to some of the world's most iconic rivers and large numbers of lakes, ponds, wetlands and canals, India is the third largest producer of inland fish in the world. The freshwater resources of India feature high biodiversity and endemism, collectively threatened by increasing numbers of invasive species, pollution, water diversion, fragmentation, and habitat loss. Fishers and local communities that rely on inland water resources in India represent an equally wide-ranging human landscape, speaking over 300 languages and coming from diverse religious, economic, and social backgrounds. These communities face severe challenges regarding resource access and livelihood security in a complex governance system. In South India, numerous fishing communities manage to combine traditional and formal management techniques in various ways, including through panchayat-style decision-making processes, government programs, and community cooperatives. We discuss the fishery characteristics, governance attributes, looming threats and potential solutions for the Cauvery River commercial, subsistence, and recreational fisheries, as well as explore the ways governance structures address community participation and socio-political equality.

1. Introduction

India is home to some of the world's most iconic rivers, an exceptional diversity of fishes, and a complex cultural landscape. India's freshwater resources include 197,024 km of rivers and canals, 31,000 km^2 of reservoirs, 2,350,000 km^2 of ponds and tanks, and 28,300 km^2 of other

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inland sources, including wetlands, brackish waters, estuaries, and lakes (Meenakumari 2005; International Collective in Support of Fishworkers [ICSF], 2016). Throughout the country, there are over 300 languages spoken at local, state, and regional scales, and 24 languages that are spoken by at least a million people (Brenkert and Malone 2005).

1.1. Indian inland fisheries

Estimates for inland capture and harvest at the national scale vary widely in India (FAO 2014). Combined fisheries sectors (inland and marine) account for between 0.75 % (Sathiadhas et al. 2014) and 1 % of national GDP (360 billion Indian rupees [INR]; Sugunan 2010). Inland fisheries capture estimates range from 781,846 t in 2007 (ICSF 2016) to 1.3 mt in 2012 (FAO 2014). In addition to wild harvest, inland aquaculture is considered a major contributor to fisheries production in India (Sathiadhas et al. 2014). Governance strategies have favoured aquaculture over capture fisheries since the mid 1980's, owing to concerns regarding the ability of capture-based fisheries to realize production potential (Sathiadhas et al. 2014). Sugunan (2010) suggested that including aquaculture and fisheries enhancements in the inland capture and harvest estimate would lead to a more accurate representation of overall inland production, which he estimated at 4.6 $mt \cdot yr^{-1}$. These estimates rank India as the third-largest inland fish producer in the world (FAO 2014).

A wide variety of gears are employed in the inland fisheries of India, including rod and reel, handlines, set lines (whether from boats or stationary objects such as trees), drop lines attached to floats, cast nets, and gill nets (Meenakumari 2005). 'Gearless' fishing practices can include traditional 'grouping' methods, where fish are encouraged into congregations and handpicked from the water, pots, traps and fish barriers, and various forms of stupefaction (including electrocution, dynamite, poison; Meenakumari 2005).

As an activity, fishing is associated with poverty and a lack of education in many parts of India (Sathiadhas et al. 2014), yet there is little information available on socio-economic attributes of Indian inland fishers. Income distribution in fisheries appears to favour the mechanized and retail parts of the sector (Sathiadhas et al. 2014), but the proportion of these economic benefits that reach local communities is unknown and likely highly variable. Further, literacy rates are also highly variable among fishing communities, and indeed, among fishers (there are no stable trends in differential literacy rates among male and female fishers across communities; Sathiadhas et al. 2014).

1.2. Productivity and stocking regimes

In India, man-made reservoirs (including tanks and ponds) produce the most harvest for inland fisheries, and are considered to have the most growth potential (Sugunan 2000). Small reservoirs require intensive stocking and are essentially culture-based fisheries, while large reservoirs are supported by wild stock and more closely resemble capture-based fisheries (Sugunan 2000). This reliance on reservoirs for inland capture has resulted in a multi-decade stocking program throughout India that was initially intended to boost production and social

equity among fishers, but has also led to various social and ecological impacts (see Invasive Species in 'Issues and Constraints' below; Raj 1941; Sehgal 1999; Sugunan 2010).

Stocking activities are generally undertaken at the state-level, and previously meant to stock native species in natural rivers (Sugunan 2010; but see also Sreenivasan 1976 for descriptions of deliberate introductions of non-native species to avoid overfishing of native species). The rearing process for fish stocking has at times included the spawning and fertilization of multiple species in a common pool (i.e. broadcast and common pool spawning techniques), potentially resulting in hybrid progeny (Sehgal 1999; Sugunan 2010). *Catla catla*, *Cirrhinus mrigala*, and *Labeo rohita* have been the most commonly stocked species in Indian rivers since the 1970s, though introductions of *Tilapia* spp. have also occurred (Sugunan 2010). Several of India's most popular recreationally fished species are currently listed as threatened (e.g., mahseer, *Tor* spp.; see various species accounts in the International Union for the Conservation of Nature Red List of Threatened Species; IUCN 2016), but stocked mahseer populations are suspected to also play a role in localized endangerment of other species (see 'Invasive Species in "Issues and Constraints' below).

1.3. National fisheries governance

Indian fisheries governance systems play out across multiple scales and requires the cooperation of numerous agencies. Throughout India, and including all fisheries sectors, communities have been organized into over 11,000 fisheries cooperatives, 70 district/regional federations, 15 state-level federations and 1 national level federation (Sinha and Katiha 2002). The Department of Animal Husbandry manages the financial and institutional support of fisheries policy at the national level and coordinates with the Departments of Fisheries at the state level (Sugunan 2010). A number of additional agencies, such as the National Fisheries Development Board, Fish Farmers' Development Agency, and Fisheries Research Institutes have also been developed to support fishers' needs (Sinha and Katiha 2002; Sugunan 2010). In some instances, cooperation with other national departments such as the Ministry of Home Affairs, Defence and External Affairs, and Commerce is also required (Sugunan 2010). In areas where reliance on fishing for livelihoods is high, state fisheries departments may also provide housing and equipment such as coolers and nets (Joshi et al. 2012). Legal pluralism and traditional forms of governance such as caste panchayats, a group of elders in a community responsible for making decisions, also occur throughout the country (Bavinck 2001).

The national and state governments own all inland waters other than small ponds, but fishing rights are allocated to individuals, groups, and communities (Sugunan 2010). These rights are managed in various ways according to international water law, locally-, regionally- and state-specific regulations and cultural practices, under the legislation described in the Indian Fisheries Act 1897, though a comprehensive account of water laws at the national scale is lacking (Cullet 2007). Rivers are ostensibly managed as a common pool resource, except in a few states (e.g., Karnataka) where leases may be held or purchased (Sugunan 2010).

2. The Cauvery River

Along with the Godavari and the Krishna, the Cauvery is one of the principle river systems originating from the Western Ghats (Sehgal 1999; Figure 8.1). It is one of few rivers known to be affected by both monsoonal directions, North-East in early summer, and South-West in late fall, though the summer monsoon sometimes fails in the area (Raj 1941). River flows return to dry season levels in the fall, typically September or October (Raj 1941). Annual average flows in the Cauvery are 21.36 $km^3 \cdot yr^{-1}$ (compared to some of the larger rivers likes the Ganges 525.02 $km^3 \cdot yr^{-1}$, or the Indus 73.31 $km^3 \cdot yr^{-1}$; Kumar, Singh & Sharma 2005). In terms of biodiversity and fisheries yield, the Cauvery is not the most productive river in India, but it is among the most heavily used rivers for irrigation and is culturally, spiritually and economically significant in the states through which it passes: Karnataka and Tamil Nadu (tributaries of the Cauvery also pass through the neighbouring states of Kerala and Puducherry). Further, the Western Ghats (where the Cauvery headwaters begin) is part of a global biodiversity hotspot (the Western Ghats-Sri Lanka), implying that significant loss of biodiversity in this region could lead to large losses of endemic species (Indian Institute of Science 2004).

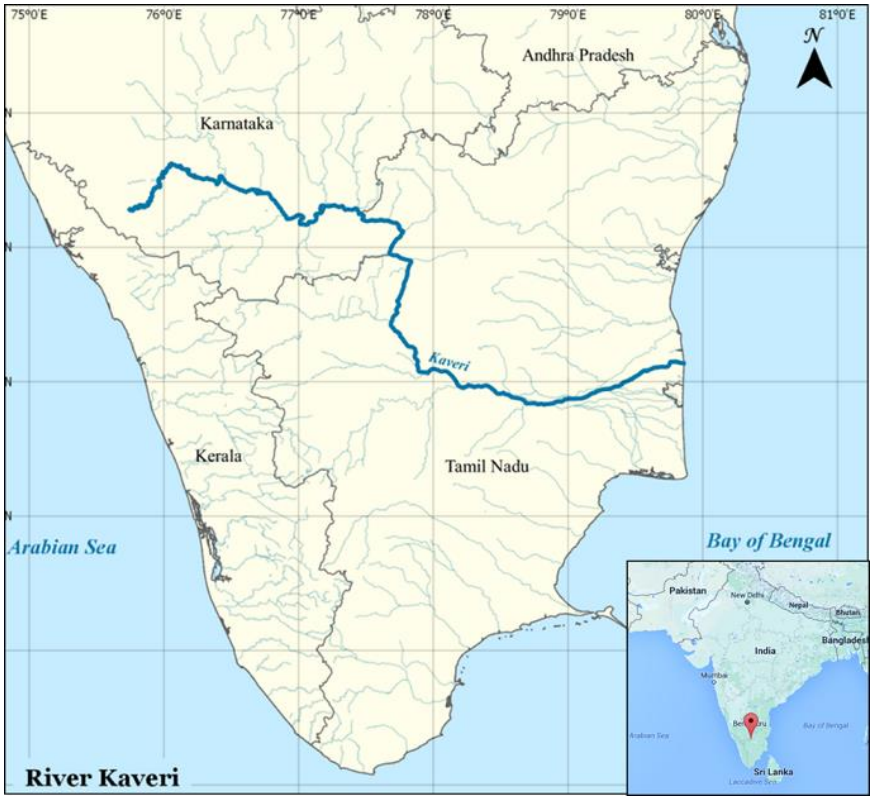

Figure 8.1. Map of state borders and rivers in South India, with the Cauvery (Kaveri) highlighted in darker blue. Inset indicates the location of the Cauvery River relative to the whole of India.

The Cauvery is known to host at least 100 fin fish species and over seven prawn species (Srivasatava et al. 2009; Sugunan 2010; FishBase 2015), though additional species may yet be undiscovered. Cyprinids are the dominant group of fishes in the Cauvery, which includes *Tor*

spp., *Neolissochilus* spp., *Labeo* spp., and *Cirrhinus* spp. (Sehgal 1999). In years when the monsoon is weak or non-existent, losses of young of the year and failed spawning can occur in the major carps (Sreenivisan 1976). Species known to be have been stocked in the Cauvery over time include: *Cyprinus carpio*, *C. catla*, *L. rohita*, *Tinca tinca*, *Oreochromis mossambicus*, *Oncorhynchus mykiss* and *Tor khudree*, though there are reports of fishers landing *Clarias gariepinus* as well (Raj 1941; Sehgal 1999; Indian Institute of Science 2004).

2.1. Inland fisheries of the Cauvery River

Fisheries in the Cauvery River occur across commercial (mainly small-scale, artisanal), subsistence, and recreational sectors. Commercial fisheries mainly occupy the floodplains and low lying areas of the river (Sehgal 1999), targeting a diversity of species and using a variety of gears (as described in 'Inland Fishers of India', above). In Tamil Nadu, freshwater prawns are fished in the Cauvery (Mariappan, Balamurugan and Balasundaram 2002). Statistics from Karnataka and Tamil Nadu Fisheries Departments estimate that 13,900,000 (Karnataka) and 225,804 (Tamil Nadu) fishers are active in the inland fishing sector, though the estimated number of fishers active on the Cauvery is not available (Government of Tamil Nadu 2015; Government of Karnataka 2016).

Subsistence fishers on the Cauvery River commonly use cast nets (see Photo 8.1) and gill nets (see Photo 8.2), and preferentially target medium-sized *Barbodes carnaticus*, *Systomus sarana*, *Labeo spp., Cirrhinus fulungee*, *Crossocheilus latius*, *Garra spp., Mystus malabaricus*, *M. vittatus*, *Xenetodon cancila*, *Channa gachua*, and *Mastacembelus armatus* (Sehgal 1999). An important distinction is made between subsistence fishing and poaching by management organizations: poaching being the term used to refer to subsistence or commercial harvest in prohibited areas or using destructive gears. Indian Institute of Science (2004) suggest that the trend of use for destructive fishing methods is increasing. These methods include dynamiting and poisoning, but may also include fishing outside of open seasons, use of small-meshed nets, harvest of gravid fishes (during closed season), and targeted harvest of fish at congregation sites (e.g., dams; Indian Institute of Science 2004). Mariappan, Balamurugan and Balasundaram (2002) note that prawns are collected during breeding season, where 'berried' females are harvested and the eggs are either discarded or sold to hatcheries.

Recreational anglers typically fish either from a coracle (traditional round-bottomed boat) or from shore, using mainly rod and reel, but in some instances with handline (using fishing line tied to a stick). In the two main fishing areas of the Cauvery River, Valnur (Coorg) is open for mandatory catch-and-release (C&R) fishing from October until May and WASI Lakes (Shivanasamudra) is open for mandatory C&R year-round. Anglers must purchase a membership to the relevant organization, either Cauvery Wildlife Society in Coorg or the Wildlife Association of South India at WASI Lakes, and a daily fishing license. Rod and reel is the only gear permitted for use by recreational anglers in these areas (Sehgal, 1999). Anglers typically target *Tor* spp. (Gupta et al. 2016), *C. catla*, *L. rohita*, and *Channa marulius* using a variety of baits and lures, though other species, such as *Neolissochilus wynaadensis*, *C. gariepinus*, and other cyprinids such as *C. Carpio*, *Barbodes carnaticus*, *Hypselobarbus* spp., *Osteochilichthy*s spp. are also targeted or caught as bycatch on occasion. WASI maintains

data on recreational fishing activities within its management zone, including keeping angler log books describing the number and the weight of fish caught.

Photo 8.1. A small-scale fisher throws a cast net on the Cauvery River (Photo credit: Raja PK, metophoronline.in, and Pelagic Tribe).

Photo 8.2. A small-scale fisher checks a gill net set on the Cauvery River from a coracle (a round, flat-bottom boat) (Photo credit: Raja PK, metophoronline.in, and Pelagic Tribe).

2.2. Fisheries governance on the Cauvery River

Fisheries on the Cauvery River are currently governed and managed according to national legislation (as described in the introduction) and the applicable state department policies, and also by non-government organizations (NGO), and local communities. Prior to British colonization, fisheries in Tamil Nadu were mainly governed by sabhas (assemblies), which

appointed committees to manage distinct areas (Bhushan 2009). Under this type of management, misuse of common property was noted and offenders were punished. Reports indicate that similar strategies were used to manage Cauvery River fisheries in Karnataka. During colonial times, there was a breakdown of this form of communal governance as the British instituted various forms of top-down governance structures. Post-colonial Tamil Nadu has also seen a shift to multi-scale forms of governance. An attempt to reinstitute panchayats (Madras Panchayat Bill of 1958) was not overly successful, but forms of community management do continue to occur (Bhushan 2009).

Currently, community cooperatives and state-level support systems are in place for inland fishers of Karnataka and Tamil Nadu. There are 455 active community cooperatives (both marine and inland) in the state of Karnataka, including one state-level cooperative for inland fishers (Government of Karnataka 2016). The Karnataka Fisheries Department additionally reports the availability of a number of support schemes for inland fishers, including the Distress Relief Fund, Group Accidental Insurance Scheme, CCS Housing Scheme, Matsya Ashraya Yojane (housing scheme), and additional sources of funding to support financing for cooperatives, marketing development, caste welfare and tribal fisher supports (Government of Karnataka 2016). The government of Tamil Nadu reports that there are 369 fisheries cooperative societies currently supporting 86,481 inland fishers, of which 303 offer membership to men (79,110 members) and 66 offer membership to women (7,371 members; Government of Tamil Nadu 2015).

A large degree of cooperation is required among a multitude of government departments on issues of water management. For example, in addition to local communities and cooperatives, fish are managed by state fisheries departments, riparian areas and enclosed waters surrounded by forest reserve are managed by the state forest departments, and sand or mineable materials are managed by the state treasury departments. This also applies to water tanks, which are large reservoirs (some dating back over 2000 years) that hold and supply drinking and irrigation water to numerous towns and villages. Tanks may be home to numerous species of migratory birds and other wildlife; as such, many have been deemed sanctuaries and are now under control of the Forest Department (Bhushan 2009).

3. Issues and Constraints

The more pressing problems constraining the sustainability and resiliency of Cauvery River fisheries are similar to those issues faced throughout the freshwater systems of India, namely water security, invasive species, and inter-sectoral conflict. These are broad-scale issues that encompass additional threats, including water diversions, destructive fishing methods, stocking and intentional introductions of invasive species, and sand mining.

3.1. Water security

Water withdrawals, hydropower development, pollution, and climate change are most commonly cited as major threats to riverine health in India (Brenkert and Malone 2005;

Jayaram 2005; Dahanukar et al. 2011; Everard and Kataria 2011). The heavy reliance of a large human population on the main river stem and tributaries of the Cauvery River basin has led to a number of potential and realized conflicts. The level of water diversion is high: the Cauvery River provides the main source of drinking water to Bangalore, the 3rd largest city in India. Numerous farms and tourist operations (e.g., hotels) rely on the Cauvery for irrigation, and recent instability in monsoon patterns has led to uncertainty regarding the sustainability of withdrawals. Run off from industry, farms, and plantations, a lack of water treatment for sewage, and submersion of land during the flood cycle all contribute to delivering pollutants into the Cauvery River.

Hydropower development has played a strong role in water security along the Cauvery. Numerous dams on the Karnataka side of the Cauvery have led to tension between the states of Karnataka and Tamil Nadu, whose population also relies heavily on the Cauvery for drinking water and irrigation (Sinha and Katiha 2002). In addition to the issues surrounding the equity of water distribution, hydropower development along the Cauvery has led to impacts such as the displacement of local communities in reservoir areas and is believed to have contributed to the loss of the hilsa (*Tenualosa ilisha*) fishery since the construction of the Mettur Dam in the 1930's (Raj 1941; Sreenivasan 1976). Sreenivasan (1976) suggested early hydropower developments were also a factor in the loss of the indigenous *Hypselobarbus dubius* fishery in the 1940's and 1950's.

Any of these issues may be further exacerbated by changes to the hydrological cycle (including monsoonal patterns) arising from climate change. The state of Karnataka is expected to be vulnerable to climate change issues compared to most inland states, but Brenkert and Malone (2005) note that the heavy reliance on agriculture in Karnataka renders the population most heavily dependent on this sector particularly vulnerable. Tamil Nadu was one of six states identified as being highly vulnerable to the effects of climate change, and this can be tied directly to concerns regarding water shortages and ecosystem sensitivities (Brenkert and Malone 2005).

3.2. Invasive species

Many of the threats currently impacting the Cauvery River are complicated by the issue of introduced and invasive species. As noted above, stocking practices in India began with the intention of improving fisheries productivity and supporting livelihoods. Some species that were believed to occur throughout India were stocked in areas where they were not native. Three commonly widely-stocked species, *C. catla*, *L. rohita*, and *C. mrigala*, are native to some areas of India, but have been widely introduced in many areas to which they are not native (Sreenivasan 1976). In rivers such as the Cauvery, and in the reservoirs of Karnataka and Tamil Nadu, these species have become very abundant in some locations, while native species have possibly been outcompeted (Sreenivasan 1976). This concern was reinforced by Pinder, Raghavan and Britton (2015), who describe possible near extinction of a local species of mahseer in the Cauvery River and suggest stocked *T. khudree* may have played a role in the decline. These introductions are further complicated by a lack of regulation or enforcement in some areas regarding the culture of invasive species. For example, the culture of *C.*

gariepinus has been prohibited in all Indian states, but no prevention mechanisms have been established in Karnataka (Indian Institute of Science 2004). Currently, the focus of Fisheries Department activities in both states (Karnataka and Tamil Nadu) continues to be the production and release of fingerlings to inland waters.

3.3. Inter-sectoral conflict

Inter-sectoral conflict plays out in a number of different ways on the Cauvery River, many of them subtle. There tends to be little obvious resource-based conflict as subsistence fishers and recreational anglers typically target species differently: recreational fishers tend to target specific species, while subsistence fishers will target any species available. Where target species overlap, recreational anglers fishing in the more popular areas will often practice C&R (mostly for *Tor*, *Catla* and *Labeo* spp.) and/or specifically target larger bodied individuals, while subsistence fishers often catch smaller fish using different gears. Sehgal (1999) noted that commercial fisheries target larger bodied fishes, including *Tor* spp., and exotics such as rainbow trout and common carp, similar to recreational fisheries, suggesting that there may be potential for resource based conflict among these sectors. However, while commercial and recreational fishers may have similar targets, they are also usually separated geographically (the more common recreational fishing locations are not conducive to commercial harvest). When they do co-occur, conflict among these sectors may arise.

Access-based conflict may be more of an issue than resource-based conflict on the Cauvery River. Research into issues regarding equitable access of all sector fishers to resources is recommended by Joshi et al. (2012), who note as an example that a switch in the licensing system requiring individual licensing (from family licensing) has discouraged some commercial and subsistence fishers from fishing at the Mettur Dam reservoir by favouring fishers with more money for licenses. Many of these fishers have migrated to other fishing grounds, such as the Sharavathi Basin. Joshi et al. (2012) also allude to the perceived conflict surrounding migrant fishers, often those who have been displaced (as above), or those who travel among states for work and fish for sustenance. Migrant fisher populations are marginalized voices in Indian small-scale fisheries, and are often blamed for real or perceived malpractice if they employ gears that are considered inappropriate in their new location (e.g., dynamiting). These collective potential conflicts could have important ramifications for many individuals relying on small-scale fisheries for nutrition and livelihoods.

Conflict among recreational fishers and subsistence fishers using destructive fishing methods is less subtle. Both angling organizations on the Cauvery hire ghillies (guards) to work as guides and monitor fishing activities along their leased reaches of the river. Individuals caught poaching in recreationally fished areas are reported, and gear may or may not be confiscated. This has occasionally led to tension between angling organizations and local communities in the past, and research examining these relationships more closely is warranted.

The increase in recreational fishing activity in recent decades has generated mixed opinions among local communities. Anecdotal reports in Chennai, Tamil Nadu suggest local commercial and subsistence fishers are not widely supportive of C&R activities as the concept

of C&R is viewed as wasteful. In addition, though recent studies have indicated that the main recreationally-targeted species on the Cauvery, *Tor khudree*, is physiologically resilient to the practice of C&R (Bower et al. 2016), more research is needed to understand the social context of the fishery (i.e., to evaluate community support and benefits).

Included here under the auspices of inter-sectoral conflict are potential access- and resource-based conflict issues surrounding the sustainability of harvest. While few species targeted for fishing in India are listed by the IUCN as threatened (e.g. the four commonly recreationally fished *Tor* spp., see IUCN Red List 2016), the conservation status of many other species remain unevaluated and reports suggest that catch rates in the Cauvery are declining (e.g., see Sehgal 1999). These decreased catch rates suggest that potential for resource-based conflict between all fishing sectors may rise if populations continue to decline.

Another issue that falls under the category of inter-sectoral conflict is that of sand mining. Sand mining is known to occur along the banks of the Cauvery River in both Karnataka and Tamil Nadu. Recent increases in the price of sand have reportedly made it challenging for community members to purchase sand for building materials at reasonable prices, and the high prices have encouraged the development of what is being termed 'a sand mining mafia'. Sand mining operations are known to negatively impact aquatic habitats and river flows, but the cumulative biological and social impacts of sand mining in this area are not well-studied.

4. Synergies and Solutions

Fisheries researchers in India have suggested a number of solutions to the threats currently faced by small-scale fishers in India, including the development of fisheries policy that supports conservation and sustainability through national leadership (Sathiadhas et al. 2014), enforcement of strategies against overfishing, and community engagement. National strategies for fisheries are incorporated into a series of Five Year plans; however, these plans focus on strategies for growth, not sustainability or resiliency, emphasizing a short-term vision. Joshi et al. (2012) recommend instituting preventions to guard against overfishing and fishing during breeding season. This call was echoed by Mariappan, Balamurugan and Balasundaram (2002), who specifically suggest placing restrictions on prawn harvest during breeding season in Tamil Nadu. Still others propose that protected areas have a strong role to play in conserving fish populations. Some areas where fish are known to congregate are protected as sanctuaries (Indian Institute of Science 2004), with the intention of engaging and educating local communities as to the need for protection and to encourage voluntary compliance. Similarly, some angling organizations are working to promote conservation of aquatic systems through implementing protected areas in their managed reaches and through education of anglers, and many anglers themselves indicate their willingness to pay to support these initiatives (Gupta et al. 2016).

Researchers also note the need to focus on themes of equity in access and governance, and cooperation among stakeholders (Bavinck et al. 2008; Sugunan 2010; Sathiadhas et al. 2014). Among the actionable solutions presented have been calls to afford aquaculturists the same support as agricultural workers (Sathiadhas et al. 2014), including *a priori* valuation of

freshwater losses and community impacts during decision-making processes for development and irrigation proposals (Sugunan 2010), and increased pursuit of co-management and participatory regimes to promote equity among fishing communities (Bavinck et al. 2008; Sugunan 2010).

The complex nature of fisheries governance in India may itself be one of the solutions. The combination of modern and traditional governance forms operating at multiple scales affords a rare degree of precision and adaptability in fisheries decision-making. National-level agencies are able to address the need for enforcement and have the capacity to develop long-term plans, while local-level agencies have the ability to make swift decisions based on the immediate needs of the community. However, to maximize the potential benefits from such a system, certain improvements could be made. For example, fisheries strategies (including the 5 Year Plans) should include policies for maintaining sustainable harvest indefinitely, enforcing existing regulations, and regulations controlling the stocking of fingerlings. Additionally, local and traditional methods for fisheries management could be formally recognized, and strategies for cooperation should be implemented at an official level. Care should also be taken to guard against unevenness in application of local regulations, as there are reported instances in which local policies that favour powerful individuals in the community are enforced strongly, while those that favour the marginalized are not.

Further research into some of the issues threatening the future of small-scale fisheries on the Cauvery River is pressing, including studies examining ontogenetic differences in behaviour and habitat use of target species to support prioritization of habitat types for conservation and restoration activities. Additional research examining the impacts and options for managing invasive species is also warranted. Many of these crucial issues also provide a degree of opportunity, however. For example, India may be perfectly poised to become a world leader in fishway research and design, capable of passing a multitude of species effectively, or conversely, capable of restraining the passage of invasive species.

5. Conclusion

The communities, NGOs, and government organizations managing the Cauvery River resources face numerous challenges. Fishers, fishes, and riparian and aquatic habitats are threatened by a high number of anthropogenic threats that render the long-term future of the fisheries uncertain. While many of the existing conflicts initially appear subtle, there is potential for the size and scope of these conflicts to increase. Currently, there are many NGOs and local community groups hard at work engaging and educating community members and the general public as to the threats faced by aquatic species and fishing communities, and research projects attempting to quantify various aspects of Cauvery River fisheries are underway.

The very nature of the fisheries governance structure along the Cauvery may represent the most important tool for addressing these myriad issues, and may serve as an important example of multi-level governance globally. The combination of top-down bureaucratic

structure and bottom-up community-level processes and actions may prove sufficiently adaptable to restore resilience to the Cauvery River system, and address the pressing need for improved sustainability and equity in the river's fisheries.

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CHAPTER 9

Individual Tenure and Commercial Management of Myanmar's Inland Fish Resources

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Abstract This chapter presents the current state of knowledge on "Inn" fisheries, an important fisheries management regime in Myanmar. The presentation made is based on a comprehensive review of literature, some original research data and the authors' extended combined experiences working in Myanmar. The chapter starts by revisiting the origin of the "Inn" system, shedding light on the chain of events that led to its generalization under the British occupation. It further explores how fisheries statistics are derived in Myanmar and warn about the possible underestimation of the importance of "Inn" fisheries. Recent history is then used to consider how the liberalization of the economy might pose some fundamental problems of equity and sustainability. The authors further present how these fisheries relate to wider inter-sectoral considerations in the context of rural development before finally offering some suggestions to guide future research efforts in Myanmar.

1. Introduction

Myanmar possesses an extraordinary abundance and diversity of natural resources, but it is often acknowledged that the benefits of their exploitation are in the hands of few individuals. As highlighted in this chapter, fish are no exception to this rule. Fish hold a central place in the national economy and the life of Myanmar people, accounting for half of their animal source food consumed and being only second to rice in terms of households' expenditure on food items. Traditionally, the extensive networks of rivers and floodplains have provided the bulk of fish for domestic consumption. Freshwater fish species are culturally preferred and cater to rural and poor consumers looking for diverse and affordable fresh fish and fishery products. Inland fisheries and their value chains also represent a substantial source of livelihoods, providing job opportunities for an estimated 1.6 million Burmese people (ILO 2015).

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Despite an increasing recognition of their importance, freshwater fisheries suffer from a substantial knowledge gap: statistics are rudimentary and unreliable, very little is known about fish production and consumption patterns countrywide. These limitations prevent the establishment of sound fisheries management. There are two prevailing regimes governing freshwater fisheries in Myanmar: *open* fisheries corresponding to "open access" areas where licenses are issued for specific fishing gears; and *leasable* fisheries where exclusive exploitation rights for delimited water bodies are auctioned by the Department of Fisheries (DOF). We hereby intend to partly address the information gap by studying in more detail the *leasable* fisheries. Commonly referred to as "*Inn*" fisheries in Myanmar, it is reported to govern 22% of the national freshwater fisheries production volume (DOF 2015).

The present chapter proposes to successively review the origin of the system, identify its main limitations and prospects, and further provide recommendations towards a more sustainable and equitable management of the sector. Statistics and insights presented in this section are based on a comprehensive review of available literature, primary data and the authors' experience working with government institutions, local universities and civil society organizations in Myanmar.

2. Background

In Myanmar, there has been a long history of leasing inland water bodies to private individuals. The origin of the *Inn* fisheries can be traced back to the 19th century, where there is written evidence of wealthy and influential individuals who had full control over large and productive water bodies. A comprehensive and fascinating review of reports from the British colonial administration (Reeves et al. 1999) suggests that both public and private exploitation arrangements of wetlands coexisted before the arrival of the British. Private lessees of the *Inn* (so-called *"Innthugyis"*) were privileged and well-established people in Burmese society who could transfer lease rights to their descendants. *Inn* were reported by Khin (1948) as the "most important [production system] of the inland fisheries". His book provides further details on the fishing practices prevailing at that time: the water bodies were enclosed with wooden fences (see Photo 9.1) and, at the time of the year when water was receding, the fish were driven towards traps and caught. His description suggests that the *Innthugyis* were commonly reliant on local communities for capture operations and that there were two fishing seasons, with a closed season usually enforced in between to allow fish to breed.[1] In the 19th century, this individual tenure system was extended to the whole territory following the recommendations of Dr. Francis Day, a renowned ichthyologist who had been commissioned to investigate Burmese fisheries in 1869. Opposing the ostensibly unfair control of hereditary lessees over the important fish resources, Dr. Francis Day[2] expeditiously recommended to the British Administration to instore a system of auction leases through which the management of inland water bodies would be sold for 5 years to the local fisherman making the highest offer (sealed bid).[3] These recommendations were received with mixed enthusiasm. Some officers praised its effectiveness in generating revenue and others questioned the ability and legitimacy of the colonial administration to deal with "a

matter so seriously affecting the welfare of the people at large". Eventually most of the recommendations were conceded through the enactment of the *Burma Fisheries Act* in 1875. However the Act included a proviso which made "any company with at least two-thirds of its members being local fishermen" qualified to bid, de facto allowing outsiders to take part in the control of inland fish resources. In 1896, Captain F.D. Maxwell was commissioned to investigate how the sector had evolved under the new *Act*. His conclusions were alarming: he depicted an overall situation where local fishermen, incapable of competing, were subject to powerful moneylending and trading interests. Despite his warnings, the *Reformed Fisheries Act* from 1905 took a step further towards the economic liberalization of the sector and the auction became open to "any person".

Photo 9.1. Bamboo trap from a leasable fishery in the Ayeyarwaddy Region (Photo credit: Eric Baran).

Unfortunately there is still very little evidence and research available on how the management of inland fisheries resources evolved post-independence (1948) in Myanmar. However, consultations with officials and experts indicate that there was a brief tentative shift towards group ownership of the *Inn* under the socialist government (1962-88) and a return to individual ownership together with the introduction of the *open* fisheries system under the first part of the military regime (1988-2001). The second period of the military regime (2002-2010) saw a move towards a more centralized management of the fisheries: the auction system was momentarily dropped and leasable licenses were reportedly handed directly by the Minister to influential patrons close to the Regime. More recently in 2011, the government shifted back to a more decentralized system and regional administration of fishing licenses. In line with democratization, it also re-introduced the auction system, but notably it did so without defining any restriction on the eligibility of the bidders.

Despite the very limited information on how this more recent tumultuous political history affected inland fisheries management, a review of the Laws in effect and testimonies accessible indicate that the successive political regimes paid little attention to the sustainability and equity of inland fisheries management, and that the alienating foundations generalized during the British occupation still prevail. The following section capitalizes on

present-day knowledge as well as on a comprehensive survey[4] of 180 leaseholders randomly sampled across 12 townships of the Ayeyarwaddy Delta and Yangon Regions (see Figure 9.1) to offer a critical assessment of present challenges and future prospects of Myanmar's leasable fisheries management.

3. Challenges and Prospects

3.1. The hidden importance of leasable fisheries

Like many other developing countries, Myanmar is characterized by a poor fisheries data collection system. Since 1994, the responsibility of all fisheries data collection fell under the Planning Division of the DOF. There is nowadays a growing questioning by the international fora about the substantial volume and the growth of the overall Burmese fisheries production which went from 0.83 mt in 1994 to 5.05 mt in 2013. These numbers are largely believed to reflect the government's targets rather than actual production levels (BOBLME 2014). The accuracy of these figures is being challenged by emerging evidences from stock assessments and consumption surveys (Belton et al. 2015; Needham and Funge-Smith 2014; Krakstad et al. 2015) which point toward an overestimation of the overall Myanmar fisheries production. Looking more specifically at the way freshwater fisheries statistics are computed helps understand their limits and better apprehend how they could be misleading. *Leasable* fisheries catches are theoretically compiled based on yearly recall data which are supplied by the leaseholders to the DOF. However a FAO study (BOBLME 2014) found that reported figures conform surprisingly well with targets set by the government. As for *Open* fisheries, catches are supposedly based on monthly catches compiled by DOF officers, but limited human capacity together with the scattered nature of fishing operations mean reported figures are also questionable.

A more recent study (Khin et al. 2016) suggests that *leasable* fisheries annual yields are in reality estimated at the local level based on the surface of each lease multiplied by constant biomass per unit area.[5] The same principle would be used to infer on *open* fisheries statistics where the count of licensed gears is allegedly multiplied by a constant assumed biomass harvested. These target-led approximations are misleading our understanding of both the *open* and *leasable* sub-sectors. There is another larger bias in the case of *open* fisheries where yield statistics are amplified by the fact that the DOF is issuing a growing number of licenses every year. An analysis of the reported fisheries production sub-sectors from 2003 to 2015 reflects this: yearly annual production growth rate across all sub-sectors is 9%, except for *open* fisheries where annual production growth rate is 12% over the same period.[6]

This trend has important consequences on the perceived reduced importance of leasable fisheries. They accounted for 45% of the inland fisheries production in 1994 and are now assumed to account for only close to 22%. To our knowledge, there is no biological foundation to explain such relative variation of productivity. In reality, multiple evidences indicate that *leasable* fisheries are the most productive fishing grounds across the country. Our recent surveys across the Delta show that both *leasable* and *open* regimes apply to

Myanmar Information Management Unit

Fisheries Survey Site Location on Ayeyarwady Region

Funded by European Union Humanitarian Aid

Canada

Legend

- Site Location
- Coastal Line
- Township Boundary
- State/Region Boundary
- Road
- Railways
- Project Township
- Water body

Map ID: MIMU1353v01
Creation Date: 16 September 2016.A1
Projection/Datum: Geographic/WGS84

Data Sources: Worldfish
Base Map: MIMU
Boundaries: MIMU/WFP
Place Name: Ministry of Home Affairs (GAD) translated by MIMU

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www.themimu.info

Figure 9.1. Study sites

similar water ecosystems.[7] Most of the leased areas correspond to productive segments of river channels assumed to be located on the migration paths of commercial species and often encompass known breeding areas.[8] In addition, a recent study by FAO (BOBLME 2014) and discussions with DOF officers inform that it is common practice for unproductive (and therefore unprofitable) leased water bodies to be "decommissioned" and then converted into agricultural land or open water bodies.[9] These observations and the recognition of the ecological importance of leasable fisheries would attach central importance to the *Inn* and place their sustainable exploitation as a priority for improving the management of Myanmar's inland fisheries resources.

3.2. The exclusive system and the capitalist race to exhaustion

Our study indicates that the size of leased water bodies in the surveyed area ranged from 50 to 420 hectares[10], and that their annual price in 2014 ranged from US$ 97 to US$ 5,726. In spite of the important variance observed between the surveyed leases, only 16% of them had an annual price below US$ 500, 17% between US$ 500 and US$ 1,000, and the remaining 67% were above US$ 1,000. This is particularly costly in the local context as the average annual income in Myanmar is estimated at US$ 1,105 per capita, with a great disparity and incidence of poverty in rural areas (World Bank 2014). A comprehensive household survey implemented in 2013[11] found that 60% of households in coastal and delta areas earn less than US$ 900 per year (LIFT 2013) and several livelihoods studies conducted in the delta indicate that fisheries communities are often among the most disadvantaged. There is clearly a need for more research to better apprehend the profile of people currently holding leasable fishing licenses as well as the distribution of benefits to local communities overall. Our exploratory survey provided some strong indications that the system is exclusive with 86% of the surveyed leases being owned by individuals of whom 61% resided in a different village than the fishery. All the leaseholders surveyed were employing at least one non-family laborer to operate the lease, with some leaseholders reportedly employing over 500 employees. In some cases (13%), leaseholders practiced sub-leasing and allegedly provided local communities with fishing access in return for a daily fixed fee. 72% of the leaseholders reported incidences of poaching from surrounding communities.

In addition to the problem of accessibility for smallholders, the current management regime also carries significant threats for the sustainable use of inland fish resources. First, exploitation rights are always initially obtained for one year and, despite efforts under the recent reformist government to allow for longer management periods[12], there is still a substantial turnover in leases ownership: 46% of the leasable fisheries surveyed had been issued for less than a year. This understandably limits the interest of leaseholders to guarantee the sustainability of their operations. A closer look at recent history helps to shed light on an additional negative effect of the capitalist administration of the lease in terms of sustainability. After dropping the system of auction lease over several years under the military regime, the reformist government ordered its re-introduction in 2011. An analysis of surveyed lease prices evolution over the past 8 years shows that although only 6% of the leases prices increased from 2009 to 2011, this proportion increased to 21% in 2012 and 72%

in 2013. These observations clearly suggest that economic liberalization is resulting in an overall increase of the leasable licenses fees. This not only makes it more difficult for smallholders to afford but also induces an increased pressure on the resources. The more money one spends on acquiring a fishery, the more resources this person will need to harvest in order to make profit. This is further enhanced if there is no guarantee that tenure will be extended after the first year. Indeed preservation measures are generally ignored: less than half of the leases reported to include a known breeding area were subject to some protection measures.

Although many challenges currently compromise the equity and sustainability of freshwater fisheries in Myanmar, the ongoing decentralization and promulgations of regional fisheries Laws offer unique opportunities. Whether it is the original idea of Dr. Day (1869) to auction the lease "only to *bona fide* fishermen for a period of five years", or the later recommendation from Maxwell (1896) to "divide existing fishing lots in smaller units affordable by smallholders", there are many valuable suggestions which could help fostering a more inclusive and sustainable management system.

3.3. The leasable fisheries in the wider context of rural development

There has been a failure from earlier governments in Myanmar to recognize the importance of the fisheries for the rural economy. In the late 19th century, the British government made rice production a priority and this narrow approach to agricultural development was mostly maintained through the successive post-independence political regimes (Odaka 2016). Thus there has been a missed opportunity to recognize the integrated nature of resources utilization. This has repeatedly led to some conflicts, particularly for land and water use. Conflicts for land are particularly apparent in leasable fisheries established on seasonally flooded environments where it is common practice to cultivate part of the land emerging during the dry season, at the time of the year when the water has receded. This characteristic was reported in 34% of the leases visited, but surprisingly, only 14% of these lands are actually cultivated by the leaseholders and their relatives, with the remaining 86% being cultivated by communities adjacent to the lease. In other words, the leasable license only provides authority over submerged portion of the land which varies spatially throughout the year. There are currently no provisions for this off-season arrangement under the Law. Despite the limited cases of conflicts formally reported by leaseholders during our survey, further discussions with fisheries officers indicate that this practice prevails throughout the country and local officers are frequently solicited to resolve related conflicts. This land use consideration surely needs further research, but it is very probable that tacit agreements which have developed over long periods of time have been further challenged by the liberalization and the consequent repeated changes of lease ownership.[13] Our survey shows that current demarcations of leasable fisheries still rely largely on outdated and inaccurate maps, sometimes inherited from the British (see Figure 9.2). Conflicts over water usage were also commonly observed and 80% of the interviewed leaseholders reported being affected by water purposely withdrawn for domestic or agriculture purposes in neighboring areas. The ministerial separation of the agriculture and fisheries sectors initiated under the socialist era,

together with the seemingly limited coordination under recent regimes, made it difficult for the government to properly understand and address these important issues. But recent history is encouraging: in 2016 the new government (2016) merged the departments of agriculture, irrigation and fisheries under a single Ministry. This fusion represents a unique opportunity for policy makers to better apprehend such interactions and ensure that resources are managed in a more integrated and equitable fashion.

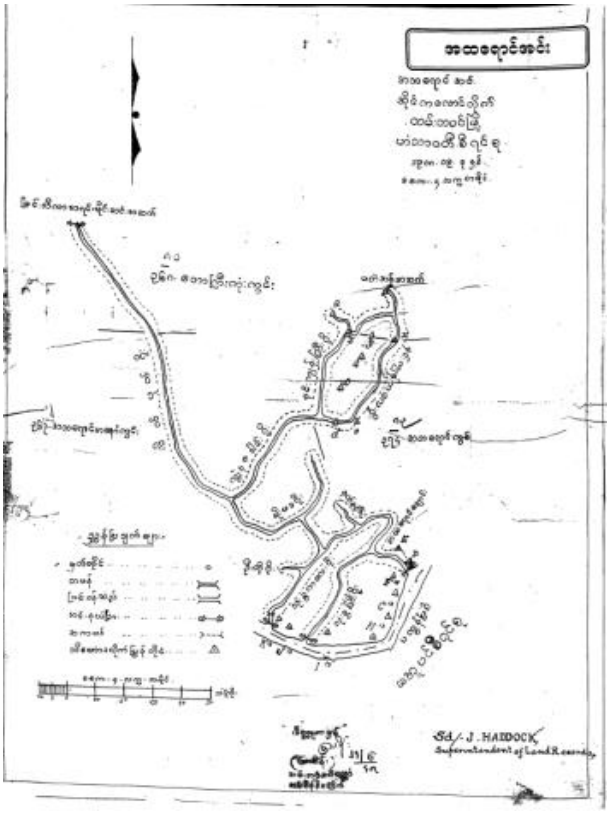

Figure 9.2. Leasable fisheries map dated from 1908 still being used (Source: Department of Fisheries Yangon Region).

4. Discussions

The aim of this chapter was to shed light on *leasable fisheries*, a relatively little known to outside yet very important management regime of Myanmar's inland fisheries. It is important here to emphasize the main limitations of this study. The sample covered only 2 of the 14 regions and states of the country and there was an important variation observed between the leases in terms of their natural environment and management conditions. Therefore some of the observed trends and deductions might only reflect part of the reality. The study revisited the roots of *leasable* fisheries and described how this old practice has been shaped by the unique political history of the country. We suggest that *leasable* fisheries are a more important contributor to freshwater fisheries production than commonly assumed. Building on original data from a survey implemented in the Ayeyarwaddy delta, the chapter highlights the lack of equity and sustainability of the current system. It also stresses the historical

inability of the government to appreciate and address freshwater fisheries challenges in the wider context of rural development. Despite its exploratory nature, our study sets some basis for a priority research agenda: we believe there is an urgent need to review the current inventory of *leasable* fisheries in Myanmar in order to better understand the variety of environment and management conditions. In many respects, reported *leasable* fisheries operations were comparable to aquaculture with 86% of the leaseholders being individuals, of whom 59% reported providing feed to the fish and 79% stocking fingerlings.[14] A detailed inventory would help to identify the most productive areas as well as the ones which have potential for resource recovery through conservation and improved management. There is surely a need to better ascertain who are the present leaseholders and apprehend what is the distribution of benefits under the current system. In parallel, more research efforts should be deployed to the *open* fisheries environments and the people who depend on them. Despite the rather challenging circumstances depicted in this chapter, the authors recognize that there are some exceptional prospects ahead: some of the very simple adaptations looking at improving the existing practices instead of supplanting them should be tested. This should be done through a careful and inclusive negotiation process with stakeholders currently depending on the leasable fisheries areas for a wide range of purposes.

Notes

[1] The report explains that fishing seasons were from September to November and January to March with a closed season from April to August.

[2] Through their revision of British colonial reports, Reeves et al. (1999) explain that Dr. Francis Day was a medical officer by formation and that he visited Burma only once from May to November 1869, witnessing only one lease in operation during his stay.

[3] Dr. Francis day recommended for the eligibility to be restricted to bona fide fishermen residing within four miles of the fishery.

[4] As part of an ACIAR-funded project in Myanmar jointly implemented by WorldFish and the Department of Fisheries (MYFish), a collaborative research team selected 12 representative townships of the various agro-ecologies in the Ayeyarwaddy and Yangon Regions and randomly selected 15 leasable fisheries in each township (180 in total), representing 14 % of the total 1,265 leases recorded in these regions area or 5% of the total number of leases across the country. A comprehensive questionnaire – covering livelihoods, environment characterization, management, production and post-harvest aspects - was administered to each of the lease managers.

[5] This constant is assumed to vary from a place to another depending on the local productivity (Khin et al., 2016).

[6] DOF Statistics are categorized into Aquaculture, Inland (open and leasable reported separately) and Marine productions.

[7] 96% of the surveyed lease corresponded to river channels and combination of river and wetlands, the remaining 4% being artificial lakes.

[8] 32% of the interviewed leaseholders (58) reported knowing that their lease included a fish breeding area.

[9] There were 4,006 leases prior to World War II (FAO-NACA 2003). For the 2012-2013 period, the total number of registered leasable fishery areas was 3,729 of which 3,304 were leased and operated, while 425 leases were not leased (DOF 2014)

[10] The average size of leased water bodies in the surveyed area was found to be around 150 hectares. Some of the lease being situated in seasonal floodplain with their level of water strongly fluctuating throughout the year varying, their size was considered to be an average between maximum and minimum levels.

[11] The survey was implemented by the Livelihood and Food security Trust Fund (LIFT 2013) and covered over 100,000 households across the Ayeyarwaddy delta Region and Rakhine State.

[12] Since 2011, the duration of the lease is for 1 year after the auction but there is the possibility to renew for up to 3 periods of 3 years (depending on the Region) without another auction.

[13] As reported in the historical background, we know that for at least two different periods of Myanmar history, the same individuals have hold the management of the leases over several years: first before the enactment of the Burma Fisheries Act (1875) and later during the second period of the military regime (2002-10).

[14] As part of the conditions set by DOF, it is mandatory for leaseholders to invest between 1% and 3% on stocking fingerlings.

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CHAPTER 10

Modern Acts, Conservation of Fish and Colonial Interest: Inland Fisheries in Mid-Ganga *Diara* Ecology, India

Vipul Singh[1] *& Sonu K. Gupta*[1]

Abstract Early modern regimes in India did not impose any tax on *fisheries.* After getting the grant of *diwani* or land revenue rights in 1765 the British East India Company tried to re-define all traditional rights through modern Acts and Legislations. It gradually established state control over rivers, lakes and ponds, and thus transformed the pre-colonial way of surviving the adverse ecological setting. State control over water meant control over access to river water. This considerably changed the pre-colonial relationship between the river-dependent communities of fishermen and fisheries. By the last quarter of the nineteenth century, many colonial reports recommended that fisheries might prove a valuable source of revenue for the state. It was after this that the British government passed two inland fisheries acts. For a large fishing community living in vulnerable *diara* landmass the modern acts became all the more distressing. This paper attempts to understand these acts in the light of European notion of fisheries conservation and colonial interest to control water regime.

1. Introduction

The history of control over natural resources in India is very old. From the very beginning in sixth century BCE, the states depended on the amount of control they were able to obligate on resources. To maintain its own standing army any state would look for newer avenues of earnings. In fact, the origin of land revenue as a major source of income could be traced to the requirements of the expanding states. The ruler as the head of state began to be accepted as having certain rights over land, and therefore, land revenue remained the fulcrum of state society until the time the British ruled as colonial power. Although many medieval and early modern states made effort to dig canals, tanks, ponds and wells for the local communities, control over the resources from water bodies such as inland fisheries was rarely intended to be part of state income. The state did not assign much importance to revenue from the fishing business as it was scattered, and therefore, imperceptible. Land revenue happened to be the main source for all ruling authorities until the mid-eighteenth century, when the trading companies such as the East India Company emerged as rulers of

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Bihar, Bengal and Orissa provinces. The colonial rule in India under aegis of the British crown brought with it many European concepts that included modern acts of taxing inland fisheries. The government redefined many long existing traditional rights of the communities and revenue rights of the state. Unlike the medieval rulers, the colonial administration looked at the rivers and water bodies as an important resource. The status of fisheries changed drastically because the government could now foresee the prospect of income from the fisheries. In the eighteenth and early nineteenth centuries access to water was important for their control over trade. The British Crown took full-fledged control over India from the East India Company in 1858 by the Government of India Act. After this, the British government began to invest massively on canal construction and embankment of rivers as their focus had now shifted from pure trade to administering the vast territory.

Earlier, laws with limited direct implication on local communities were instituted by the colonial government such as the Bengal Regulation VI of 1819. This was the beginning of a fresh attempt not only to codify a European law but also to regulate the movements in rivers. Later Ferries and the Charter Act of 1833 were introduced (Cullet and Gupta 2009). After 1858, the British control over India became very firm and they began to invest in the management of water bodies by regulating canals and providing irrigation facilities. It began to control access to water, and the common people's right to water was regulated through the gradual introduction of European principles. It advocated that in terms of groundwater, landowners had essentially unlimited right to access to water, but in the relation to canal water, the riparian rights allowed a landowner the right to use only a limited portion of the flow of a water. A series of regulatory statutes were also enacted, including laws to protect and maintain embankments and to acquire land for embankments, such as Embankment Regulation Act 1829; Bengal Embankment Act 1885. Canal Act was passed in 1864. Certain laws such as India Ferries Act 1878 were introduced to regulate canals for navigation purposes and taxes were levied on the users.

Other than providing irrigation facility and protecting people from flood, there were other dynamics to the construction of canals and embankments. There were various financial interests, which allowed such a huge project to be underway (McGinn 2009, p. 13). The implications on the water regime in general were grave. The benefits to the fisheries in particular also got diminished in the long run. At the same time, excludability and subtractability became more evident. Rivers that were being embanked and canalised as 'commonisation' process, actually led to 'decommonisation' in the long run (Nayak and Berkes 2011). Also an early twentieth century engineer, William Willcocks has suggested that the colonial engineers were possibly mistaken by their success of the flood control projects that worked wonders in Punjab and the United Provinces. The mid-Ganga plain is very flat in comparison to Punjab and the United Provinces, and many rivers confluence the main river Ganga. The flow of water is more spread out, and thus does not provide any natural embankment to the rivers (Singh 2017). In that sense, the geomorphology of the mid-Ganga basin was completely different, and therefore, according to Willcocks (1930, p. 59), the colonial engineers "blundered badly" here. It was subsequent to gradual progression of control over water bodies that inland fisheries began to be considered as a major loss for the

state, as inland fisheries had previously provided good income for the local fishing communities of Bihar, a state located in mid-Ganga basin (see Figure 10.1).

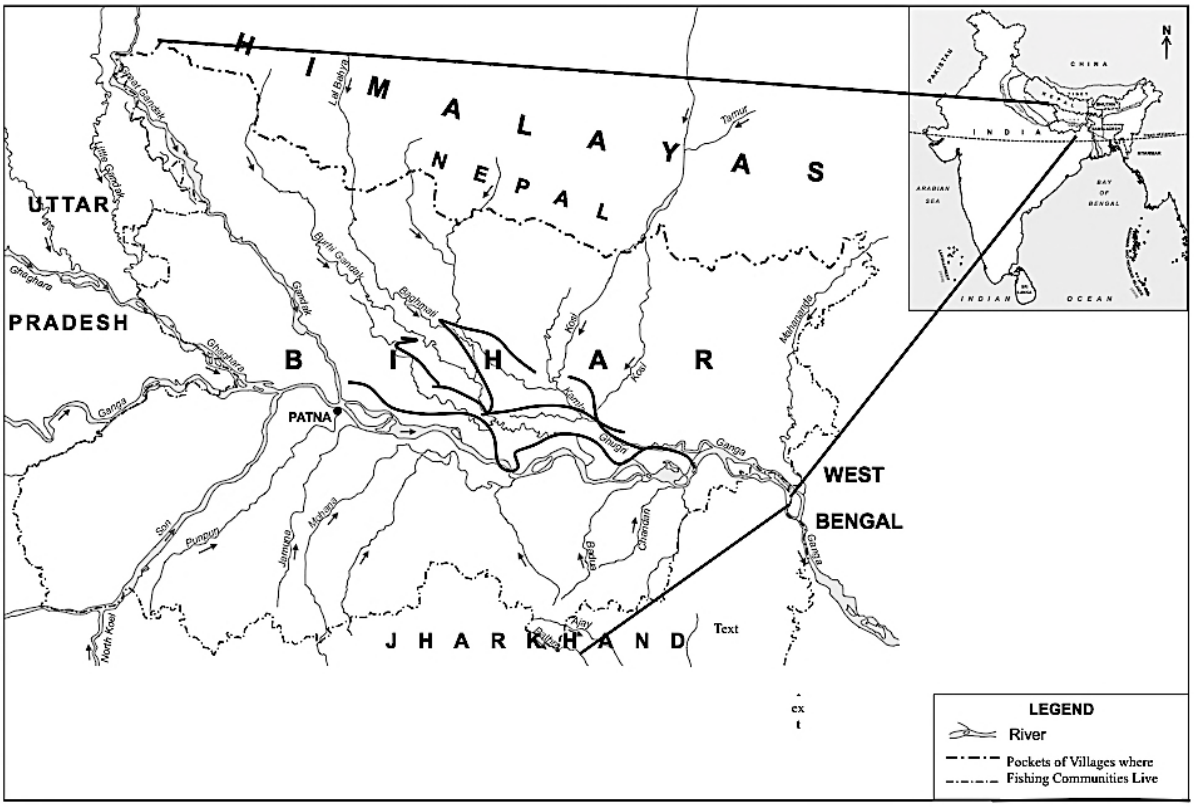

Figure 10.1. Mid-Ganga Basin and Pockets of Fishing Community Villages.

The early modern regimes did not impose any tax on fisheries, which was the economic basis of the *diara* community. After the grant of *diwani* or land revenue rights in 1765 the British East India Company tried to re-define all traditional rights through modern acts. It gradually established the state control on the rivers, lakes and ponds, and thus considerably changed the pre-colonial way of surviving the adverse ecological setting. The Company introduced water tax or *jalkar* (*jal* being water and *kar* is tax) in lakes and ponds in the area directly under their control. Over the nineteenth century, *jalkars* came into the possession of *ijaradars* and they, who were able to charge fishermen for access to the fisheries. The *ijaradars* were basically revenue farmers, and the East India Company's government during its early period of rule farmed out revenue to the *ijaradars* by putting its directly controlled land on auction. The larger portion of land in Bihar, Bengal and Orissa was under the control of the *zamindars*, who were the traditional land holders of huge land. The government entered into a revenue settlement with them in 1793, what is known as the Permanent Settlement. Under the terms of the settlement, the *zamindars* were given hereditary rights of their *Zamindari* or tradition land, and they were required to pay 89 per cent of the land revenue collected from the farmers to the government, and retain 11 per cent with them. In terms of fisheries, the *zamindars* did not collect any tax or *jalkar* from the fishermen. The available archival sources of the early nineteenth century are absolutely silent on such

taxation in *Zamindari* land. In fact, there was no concept of license or permit till very late in the nineteenth century.

The Bengal Private Fisheries Act, Act II of 1889, however, allowed the *zamindars* to control private ponds and tanks in which fish were cultured for private use. Now there were no free inland fisheries, in which the public could have access without license.

2. *Diara* Ecology

The mid-Ganga basin is home to many rivers. Rivers coming down from the Himalayas and the Deccan plateau meet the Ganga in the modern state of Bihar. When the rivers come down as swollen rivers from the Himalayas during summer they deposit the sand and sediments in the main riverbed during the process of retreating. This leads to the shifting of the course very frequently and emergence of new land almost every year. *Diara* is basically the vast landmass around rivers formed like an island due to silt deposition over a long period of time by the Ganga and its tributaries. R. H. Colebrooke in his map of 1796-1797 has shown the land that once inside the river and now occupied by the villagers. It is in this vulnerable and temporary landmass that the fishing communities have been living for centuries (see Photo 10.1).

Photo 10.1. House of fishing communities in *Diara.*

The formation of the new islands in one part of its course causes sweeping away of some old lands and emergence of new ones in other parts (Singh forthcoming). Therefore, in such changing landscape the right of ownership was an issue. Normally, the long usage of the land along the coast of the river by a family gave it the right of possession of any new land formed by the changing course of the river along the coast. However, on islands, beds or spaces formed by the rivers, there was no unanimity over the ownership. A landholder on either side may claim a right over these formations. The complex fluid character of *diara* landscape had never created any dispute in the pre-colonial society. The frequent cutting and deposition of

soil led to instability and uncertainty for the people inhabiting this area, and therefore, no permanent land tenure system could develop here. Because of frequent process of creation and dissolution, the communities living here were able to produce only one winter crop, and that too after the receding of floodwater after October every year (see Photo 10.2). The fishermen were free to catch fish from the riverfront (see Photo 10.3). The British began to consider *diara* land as loss of revenue on an enormous mass of land, which used to come up after annual inundation. The huge riverfront of the *diara* also began to be seen as potential fisheries zone for taxation. The government assumed that the lands crisscrossed by rivers were 'underutilised' and thus needed to put to better handling. The British East India Company, which had come to India in the seventeenth century as a trading company and had been able to acquire land revenue rights in Bihar, Bengal and Orissa in 1765 from the ruling Mughals, aimed at stabilizing the fluid landscape. Once it realized that the unsettled *diara* land was loss of huge revenue, the British East India Company sought to settle all disputes liable to arise in future on the possession of the *diara* land. For this, the Regulation XI called the Bengal Alluvion and Diluvion Regulation was passed in 1825 as a kind of tangible *diara* legislation.

The vulnerability and temporality of the *diara* landscape did not allow any permanence in cultivation. For the communities living here, river fisheries were the main livelihood (see Photo 10.4).

Photo 10.2. *Diara* land filled with huge amount of silt after receding of the flood water.

3. European Notion of Conservation of Fishery

The British inland fisheries policy was unprecedented and unique to India. By the second half of the nineteenth century the British administrators in India began citing the case of England and Scotland as the basis for the eventual enactment of Bengal Private Fisheries Protection Act of 1889. This does not, however, suggest that the 'modes of production and social relations' in colonial India were not the result of 'cultural or economic imperialism' as has been argued by Ravi Rajan in the context of forestry. He has shown that there was nothing

distinctive about forestry as practiced in the colonial context (Rajan 1998). To him 'environmental imperialism' was the outcome of the 'transplantation' into a colonial territory of the type of forestry idea that was in place in Europe. On the contrary, in the context of inland fisheries the economic agenda and financial interest of the colonial state was very much in place when it came to transplanting a European model or notion of inland fisheries.

Photo 10.3. Fishermen catching fish in their immediate riverfront.

Photo 10.4. Fishermen taking out fish from the leased river water.

In England, a free fishery or exclusive right of fishery could be possible only through royal permit (BPPFA 1889, p. 105). An individual claiming a right of fishery must show the foundation of his claim. In all navigable rivers, people in general were allowed to fish, and if anyone claimed it exclusively, he was supposed to prove such exclusive right of undisturbed possession for thirty years or more. In the rivers that were not navigable the right of fishing belonged to the owner of the soil on either side, but in navigable rivers since the bed of the river belonged to the crown, the right of fishing was also laid with the crown. In the case of ponds, the possessor of the soil was considered the owner of the fisheries, and he could let

out the fishing right to anyone. In surrounding seas, people were allowed to fish freely. In Scotland, however, since salmon fishing was very popular so as a general rule the rights of all salmon fisheries in rivers and surrounding seas were vested in the crown. No one was allowed to fish with nets or engines without a permit (BPPFA 1889, p. 105).

In India, the right of fishery was called *jalkar*. Although traditionally, the right to fish in all large natural water bodies was usually leased by the *zamindar* at an annual rent, but taking of fish from a public navigable river in which another has a right to fish was not considered theft. Catching of fish in a navigable river did not lead to conviction of the offender. As the fish were free in nature, nobody could be said to be the exclusive owner of them. The 1889 Bengal Private Protection Fisheries Act was an outcome of the increased governmental interference in the affairs of the traditional fisheries rights. By the beginning of 1870s the Judges in the criminal court began giving judgments on infringement of exclusive right of fishery. Until then, there were rarely any decisions in the criminal court affecting the question of *jalkar* rights. Fish catching cases in navigable river were now being brought before the Court – e.g., Hurimoti Moddock v/s Donath Malo and others (BPPFA 1889, p. 105). The Session Judge of East Burdwan gave order to charge the offenders with catching fish from a river which lied in the proprietary rights of another individual – in Khetter Nath Dutt v/s Indro Jalia and others case (BPPFA 1889, p. 105). Magistrates were now adjudicating taking out fish as trespass, and it was only after the High Court intervention in 1888 that it was decided that a navigable river could not be said to be in any body's possession. One such Court case was Bhushan Parui v/s Denonath Bonnerjee, (BPPFA 1889, p. 107). It was adjudicated that the river being public, therefore could not be considered in exclusive possession of any one. In the case of a pond or tank enclosed on all sides, these were normally the property of the individual. Taking out fish from an enclosed tank was considered as theft as it was adjudicated in Queen-Empress v/s Shaik Adam Valac and others case (BPPFA 1889, p. 105). The High Court held that the tank from which the fish had been taken out was an enclosed tank in which the fishes were 'restrained from their natural liberty'. Since the fishes were unable to escape from the tank, it was practically in the dominion of the property owner, and therefore, the offender was convicted of theft. In times of flood fishing from these ponds was not restricted because such ponds depended on overflow of a neighboring channel for its supply of fish and catching fish in such season was not a criminal offense. One such case during flood months came up before the Court in 1888. Nichala Katani and his family members were charged with having taken out fish from the tank of Maya Ram Surma under Section 379 and 447 of the Indian Penal Code for trespassing. The Judges held that the fish were *feræ naturæ,* and so not in possession of the complainant (BPPFA 1889, p. 106). In many other cases the High Court decided that wild fish in a natural state were not property of any person until caught. In nutshell, till this time the High Court was still sympathetic to the fish takers, unless and until the individual property rights is not infringed.

While such cases were coming up so frequently in the High Court for judgments, the administrators were pushing to bring in legislations on the protection of private rights on fisheries (Government of Bengal 1889). The private proprietors, on the one hand looked for a legislation that could give them exclusive rights on fisheries in their area; the government officials were planning a complete state control on rivers and streams. E. C. Buck, the

Secretary to the Government of India Revenue and Agricultural department also recommended for the fisheries acts on the basis of the conference held in Delhi on 31st March and 3rd April 1888 (Government of Bengal 1888). The delegates of the Delhi conference had agreed upon certain conclusions, and recommended for some immediate measures, but not in the form of legislation. It recommended for the protection of fishes from the effect of explosives, prevention of poisoning of water, enforcement of fish ladder, regulation of fixed obstructions and engines in the river, and protection of stock-pools. The members of the conference were not unanimous, however, on keeping the rivers and streams as *feræ naturæ* for the purpose of catching fish, and the declaration of any right to fish in waters or rivers of a province by the government. The British officials, on the other hand, believed that there was a need for Acts as certain situations had not existed earlier. E.C. Buck wrote to H.S. Thomas, who was asked by the government to do a survey on the Acts, asking to visit various canals like Yamuna canal and Ganga canal. He suggested that a decision needed to be arrived at as reservoirs and natural depressions due to canals fed by canal waters also have many fishes. The colonial interest of the government was becoming pronounced.

4. Colonial Interest and Process of Transformation of Fishery Rights

After the grant of *diwani* or revenue rights in Bengal (that included Bihar, Bengal and Orissa) and subsequent expansion of colonial rule, the British government began to re-define all rights. It started with revenue related rights, but gradually brought all other land and water related rights under review. State control over water meant control over access to river water. This considerably changed the pre-colonial relationship between the river dependent communities of fishermen and fisheries. The major transformation in the policy of the British government came after 1793, when Permanent Settlement of 1793 was introduced in Bengal. *Zamindars* remained central to the British administration, as they were the traditional landlords in Bengal. They were so influential in the countryside that not even the early modern regime of the Mughal could completely annihilate them. Like many revenue related rights, the fisheries right also got transferred from the common people to the *zamindars*. The *zamindars* were given rights to the fisheries in the riverfront adjoining their lands as part of their income. They also controlled the fisheries in private ponds and tanks in which fish were cultured.

By the last quarter of the nineteenth century, many British reports recommended that fisheries might prove as a valuable source of revenue for the state. It was after this that the British government passed two inland fisheries acts, which clearly distinguished the *zamindar* entitled fisheries and state entitled fisheries. Within two decades the situation emerged that there were no free fisheries in which the public could access without license, except sea. It may be reiterated that although the fisheries rights got divided into *zamindars*' and state's, in all cases the fishing rights were leased out. It meant that river water for fishing was decommonised, and public fishing in the rivers was normally not allowed. The pre-colonial tradition of free fishing in rivers and ponds changed. The *zamindars* began the practice of

leasing out *jalkar* to *ijaradars* (i.e., highest bidder). In most cases the right of fishing was transferred with the land. They let out the fishing right to the renters (*mustajirs)*, who sometimes employ men to catch the fish for wage, or for a share. It was sometimes re-let to the traditional fishermen. The fishermen who caught fish from *zamindar* mahal gave one-third of the fish to the agents of the landlords (Hunter 1877). In Patna district, the fisheries in ponds and reaches of the rivers were annexed to the lands by which they are surrounding and were leased for very trifling sums (Hunter 1877, p. 84). In Shahabad district, in the parts of the channel of the Ganga, which in the dry season contained not much flow, the fisheries were private property and were leased (Hunter 1877, p. 92).

During its early phase the colonial government did not have much knowledge of fisheries and were interested only in the disposition or financial arrangements for *julkur*. By the late nineteenth century the financial interest of the colonial government became more apparent. Francis Day wrote in 1873, "It may be found advisable to legislate for regulating the exercise of the public right of fishing in all our navigable rivers. As yet we have been unsuccessful in our endeavours to curtail that right, or to enforce the claim of government to levy a tax from those who have been in the habit of exercising it" (Day 1873, p. 3). Francis Day was particularly emphatic on the fact that many fisheries were available free in nature. He was surprised to know that revenue was neither obtained from the fisheries in the large navigable river, which was freely open to people, nor from the private fisheries (Hunter 1876). He believed that non-regulating the fisheries under British rule had a disastrous effect. Day said that fisheries have been well regulated under government's Acts in countries of Europe, and therefore, in India too it could be managed through inland fisheries acts.

On the basis of the recommendation of Francis Day, the Indian Fisheries Bill was prepared that also included private rights and prevention from trespass on the rights of others. The example of salmon was cited to enact law on migratory fishes. Based on the law in England on salmon migratory fishes, Indian fresh water fishes were also identified for protection. It was argued that because of the natural tendency of the freshwater fishes to migrate, no riparian proprietor could claim an exclusive right in such a passing property. The exercise of such a claim would in either case be damaging to his neighbours. In the case of fish it would be more damaging because migration is the necessity of its existence. Therefore, any measure to stop the migration of fishes from one property to the other would affect their reproduction and might even cause its extinction (BPPFA 1889, p. 111). Thus conservation of freshwater fish was the main rhetoric behind new acts. Peter Reeves argues that these far reaching changes shifting the control over fisheries seriously compromised the real conservation needs of the fishes (Reeves 1995). By 1889, it was clearly notified that taking fish from a river or even from 'enclosed piece of water' would be an offence under the penal code (BPPFA 1889, p. 104). The Bengal Private Protection Fisheries Acts 1889 was enacted to serve that purpose. Few years later, Inland Fisheries Acts of 1897 (covering the whole of India) was passed based on Bengal Private Protection Fisheries Acts 1889.

5. Effect on Fishing Community of *Diara*

The erection of embankments, construction of highways and railways affected the flow as well as the course of the rivers. The rivers were obstructed from flowing freely and so flood became unruly. It led to the inundation of the homestead of the fishing communities, who preferred to migrate temporarily during the flood months. Most of the homestead in *diara* was on a mound and in the pre-colonial period the communities often remained in their villages living on the storage done during November to June every year. During the flood months they were able to sell fishes in the urban areas. Free nature fishes were most important in floods times; because flood had destructive nature; flood can be destructive to the main food resource and the economic basis of people. In this situation free nature of fisheries had played the most important role in sustaining people's livelihoods. During flood months, free fishes fulfilled protein requirement of the *diara* community. The scenario changed drastically after the British regulations on *diara* land, and thereafter, the communities living in *diara* villages did not have enough food to survive the inundation months. Resultantly, they preferred to migrate to the neighbouring urban areas during the months of July to November. Most of the poor communities of *diara* migrated every years in search of work and food. Their temporary migration in that sense forced them to become 'environmental refugees' (EL-Hinnawi 1985, p. 4). Their decision to migrate and come back to original location was the only resort and a normal adaptation strategy (Singh 2012). Over the years, the phenomena of temporary migration of many *diara* villagers became permanent in nature as fish catching from the rivers and streams, their main livelihood, had become illegal.

6. Conclusion

The colonial rule was disastrous for many of the customary rights including fisheries. It re-defined all rights and tried to take control over access to the water and its resources. The British gradually established state control over water bodies and considerably changed the pre-colonial relationship between the fishermen and fisheries. By drawing similarity to salmon of England, much of the deliberations and noting seem to suggest that government was concerned about the conservation of freshwater fishes of Indian rivers. In addition, many colonial reports from the nineteenth century began to suggest to the government that fisheries might prove as a valuable source of revenue. As a result of which, British government passed two inland fisheries acts - Bengal Private Fisheries Rights Acts 1889, and Inland Fisheries Acts of 1897. These acts, contrary to their stated intents led to more privatization of water bodies and consequently of the fishes, thus adversely affecting the income of the fishing community living in *diara* landscape. This may not be proved with a statistical account because of the paucity of data on the actual income of the fishing community living in *diara,* but the increased migration pattern over the last decade of the nineteenth century suggest that the community surviving on inland fishery might have been affected economically by the modern acts.

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CHAPTER 11

Governance and Social-Institutional Arrangement of Small-Scale Fisheries and Relationship with Non-Fishery Users in Badagry Creek, Lagos State, Nigeria

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Abstract This is the first study of its kind in Nigeria on the subject of fisheries governance and inter- sectoral relationship among Common Pool Resource (CPR) users in Badagry Creek, Lagos State. The case study of this regional water body, Badagry Creek, presents an interesting scenario which holds both histrocial and contemporary relevance. Governance arrangement is shaped largely by the historical, cultural and social value system of the main ethnic groups although also augmented by the values of immigrants from the coast of West Africa. Intra-sectoral fishing conflicts are resolved through the traditional governance system, and to a lesser extent, the modern day governance mechanism. In terms of inter-sectoral issues, fishers' relationships with practioners of both transportation and eco-tourism sectors are quite healthy and positive with a win-win outlook. However, relationship with artisanal sand miners is contentious as fishers consider their activities as inimical to their fish landings. Recommendations are made for scaled up scientific and social studies, especially involving spatial studies, which will inform an evolution of a management plan for the creek. To deepen resolution of inter-sectoral conflicts, especially with sand miners, this paper in conclusion suggests a need for a shift towards co-management regime.

1. Introduction

The Badagry Creek as an estuarine system provides a gateway between the freshwater and marine systems. It has in abundance a wide range of fish species which use the creek as temporary or permanent abode. Also, it is blessed with arrays of network tributaries which has historically ensured migration and movement of the greater proportion of fishers from the coast of West Africa, therefore resulting in the constellation of fishers in the creek.

The social setting is ordered by family blood initially among fishing communities but there has been a transition to more cooperation-based interactions among the subgroups of fishers

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to the extent that fishing interests now dominate. In this study, three eras of governance covering pre-colonial, colonial and post-colonial times are reported. Fishers affirmed that a win-win relationship exists between fishing communities and other non-fishers although the relationship with artisanal sand miners is not characterized as one.

This is the first effort at providing an outlook into the fisheries of the creek in terms of an envolvement of a fisheries governance system and supporting social institutions as well as inter sectoral relationships between fishers and non-fishers. It provides a template with which to understand fisheries governance challenges being faced by the fishers.

2. Background Description

The toponymical extraction of Badagry Creek in relation to Badagry suggests that the water body was named in recognition of the importance to the historical, religious, social and economic development of the town. There are significant historical, anthropological and archaeological evidence to suggest that Badagry has been populated at least from the Late Stone Age or 1736. This creek linking Porto Novo (Republic of Benin) to Lagos (Nigeria) and its pirogue traffic has long facilitated the transport of human (notorious for slave trade) and agricultural goods, such as rice and cooking oil. The Portuguese colonial master preferred the Badagry Port in the decongestion of the Whydah Port in Dahomey in the movement of slaves.

2.1. The fisheries

Badagry Creek (Figure 11.1) lies within longitude 2°42'E and 3°42'E and stretches between Latitude 6°22'N and 6°42'N, sharing boundary with the Republic of Benin. The portion situated in Lagos State, Nigeria, is endowed with a lagoon system, deltaic distributaries, floodplains and mangrove swamps. Also, it is directly connected with Nigeria's 960 km-long coastline bordering the Atlantic Ocean in the Gulf of Guinea, a maritime area of 46 500 km^2 with a depth of up to 50 m and an Exclusive Economic Zone of 210 900 km^2.

Species diversity and distribution in the Badagry Creek is shown in Table 11.1. The list contains 76 species across 47 families/orders of fin and shell fishes based on the works of several authors which include Elegbede and Fashina-Bombata (2013), Agboola et al. (2008), Akintola et al. (2009), Soyinka et al. (2010) and Solarin & Kusemiju (1991).

There are two main fishing divisions in the Badagry Creek: marine fishermen that settled at Yovoyan and Moba, and artisanal fishers fishing in the main channel of the creek. A variety of fishing crafts including Ghanaian dugout canoes with planked free boards, smaller local dugout canoes, and local planked canoes are used along with outboard engines with 5 to 55 HP. The gears typically used are gill nets which could be surface or bottom, drifting and/or encircling, and traps.

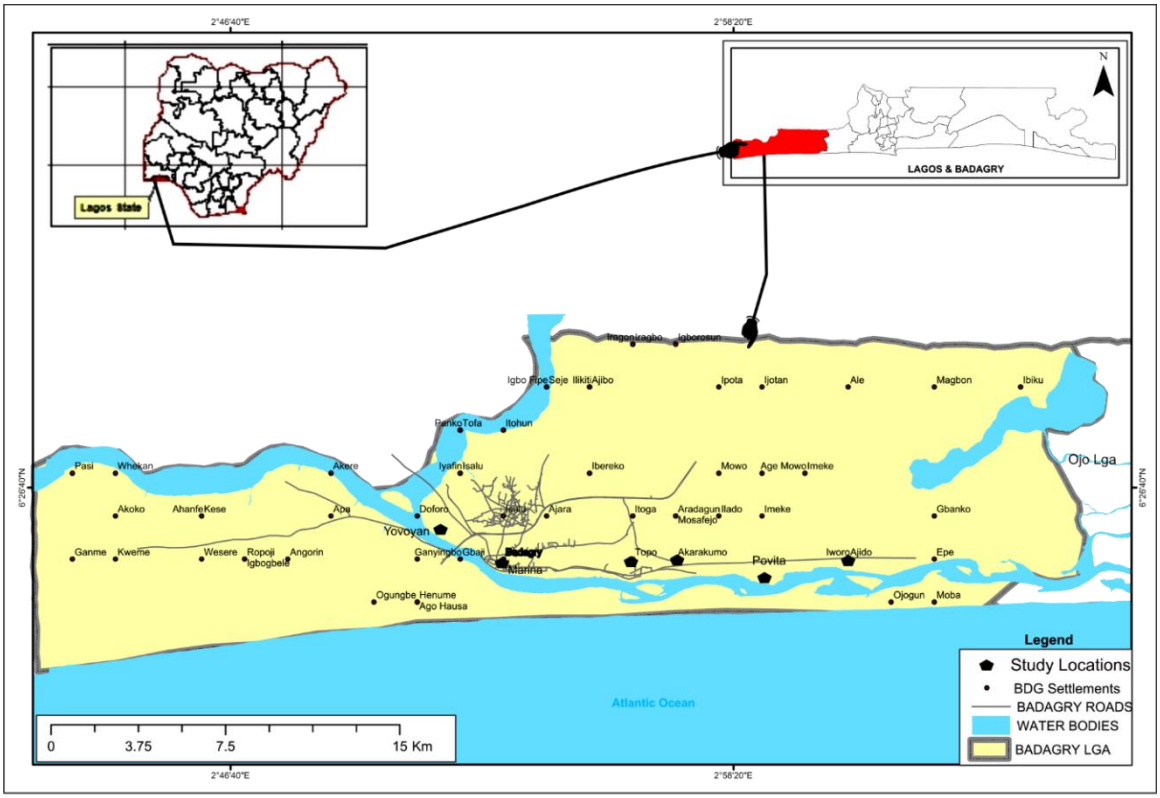

Figure 11.1. Location of Studied Fishing Communities Along Badagry Creek, Nigeria.

Table 11.1. Fish species observed in Badagry Creek, since 1991 to 2013.

S/no	Common names	Order/family	Scientific name
1	Tilapia	Cichlidae	*Oreochromis niloticus, Hemichromis fasciatus, Tilapia zilli, Sarotherodon melanotheron, Tilapia guineensis, Tilapia mariae, Tilapia melanopteura*
2	Bagrid catfish	Bagridae	*Chrysichtys nigrodigitatu, C. auratus, C. walkeri, Clarotes laticeps*
3	Sole fish	Cynoglossidae	*Cynoglossus senegalensis*
4	Jacks	Carangidae	*Caranx sp., C. carangus, C. hippos, Chloroscombrus latus,Chloroscombrus chrysurus*
5	Aba	Osteoglossiforms	*Gymnarchus niloticus*
6	Croaker	Scianidae	*Pseudotolithus typus, P. elongatus*
7	African pike	Hepsetidae	*Hepsetidae odoe*
8	Grunt	Pomadasyidae	*Brachydeuterus auritus, Pomadasys jubelini, P. peroteti*
9	Snapper	Lutjanidae	*Lutjanus goreensis, Aspilus fuscus*
10	Gobiid fish	Gobiidae	*Bathygobious soporator, Gobioides sagitta*
11	Crab	Gecarcinidae	*Calinectes spp*
12	Barracuda	Sphyraenidae	*Sphyraena barracuda, Sphyraena afra*
13	Mullet	Muglidae	*Mugil cephalus*
14	Clupeid fish	Clupidae	*Ethmalosa fimbriata*
15	Sardinella	Clupidae	*Sardinella maderensi, Pellonula leonensis,*
16	Shrimps	Penaidae	*Penaeus monodon, Penaeus notialis*
17	Prawn	*Palaemonidae*	*Macrobachium macrobachion, M. vollenhorenii,*

			M. fellicinium
18	Marine catfish	Arridae	*Arius gigas*
19	Thread fin	Polydactylidae	*Polydactylus quadrifilis, Pantanemus quinquarius*
20	Moon/finger fish	Monodactylidae	*Monodactylus sebae*
21	Catfish	Clariidae	*Clarias gariepinus*
22	Tenpounders	Elopidae	*Elops lacerta*
23	Moonies	Monodactylidae	*Monodactylus sebae, Psettias sebae*
24	Snoutfishes	Mormyridae	*Marcusenius senegalensi, Hyperopisus bebe*
25	Mullet	Muglidae	*Liza falcipinnis, Mugil cephalus*
26	Snake eels	Ophichthidae	*Ophichthus rufus*
27	Bonytongues	Osteoglossidae	*Heterotis niloticus*
28	Threadfins	Polynemidae	*Galeoides decadactylus*
29	Spotted flounder	Citharidae	*Citharus linguatula*
30	Pupfishes	Cyprinodontidae	*Parachanna obscura*
31	hook-tip moths	Drepanidae	*Drepane africana*
32	Sleepers	Eleotridae	*Batanga lebreotonis, Eleotris vittata*
33	Bichirs	Polypteridae	*Polypterus senegalus*
34	Perch	Distichodontidae	*Distichodus engycephalus*
35	Monkfish	Uranoscopdidae	*Uranoscopus polii*
36	Lefteye flounders	Bothidae	*Monolene microstoma*
37	Porgies	Sparidae	*Boops boops*
38	Needlefishes	Belonidae	*Tylosurus crocodilus*
39	West African Ilisha	Pristigastridae	*Ilisha africana*
40	Grunts	Haemulidae	*Pomadasys jubelini, P. incisus*
41	Butter catfishes	Schilbeidae	*Schilbe intermedius*
42	Suckermouths	Mochokidae	*Mochokus niloticus*
43	Patriot crab	Gecarcinidae	*Cardisoma armatum*
44	Gladiator swimcrab	Decapoda	*Callinectes pallidus*
45	Lutefishes	Citharinidae	*Citharinus sp.*
46	Flagfin Mojara	Gerridae	*Gerres melanopterus*
47	Giant African threadfin	Polynemidae	*Polydactylus quadrifilis*

2.2. Social context

The number of full time fishers is on the decline as there are many part-time fishers combining fishing work with alternate livelihoods: fishing/farming, fishing/transportation and fishing/trading in meeting financial requirements for investment, food consumption, education, health and other family needs. The most preferred fish species for consumption by

fishers is the Tilapia sp. in view of its abundance. Fresh fish are mostly preferred while fish smoking is used to preserve fishes.

Traditional history of the various subgroups Ogu (Egun), Ilaje, Awori, Ijaw (Nigerian fishers), and Agoyin and Ajase (Fishers from Togo, Ghana and Benin Republic) are well situtated within the context of migration of the coastal inhabitants. Both the local and immigrant fishers are found to spread along the bank of the creek forming territory comprising several villages and hamlets such as Apa, Wesere, Kweme, Gbaji, Gberefu, Topo, Igbogbele, Ajara Vetho, Ajara Gamathen, Ajara Topa, Alathagun, Muwo Iworo, Erekiti, Ajido, Marina, Idale, Povita, Akarakumo, Ajido, and Yovoyon. Typically, the Ogu (Egun, speaking Yoruba and Ogun languages) is the dominant ethnic group and lays claim to the creek.

The fishers exhibit strong social network behaviour within and across the various subgroups. Knowledge and information are shared and regarded as important individual or social assets but not communicated with an intruder or a new entrant. Social capital remains a strong factor and is based on family linkages which are spawned by intermarriages across the various ethnic subgroups. Bridges across subgroupings dilute the potency of class. Increasingly social relationship is moving from being defined by blood ties to ethnic folk and now to a socio-economic community of fishers (with fishing as the primary factor for association). In other words, the basis for socialisation is more gradually being defined on the basis of interest: fishing activities. However, fishers may sharply be divided against themselves at the point of fishing rights.

2.3. Governance and institutional arrangements

The various fishing subgroups still hold strong spiritual ties to their kinship across the West Coast of Africa (Ghana, Togo, Republic of Benin and others) from where they all migrated to their present point of assemblage in Nigeria. Spirituality is based on strong orientation towards supernaturalistic or pantheistic with dominance of the Zangbeto adherence. Although there is a constellation of religious groups like Islam and Christianity- the modernist religions, the fishers demonstrate unbroken ties with their gods. It is from this background that fisheries governance and institution may be gleaned from three eons of precolonial, colonial and post-colonial.

Precolonial fishing policies were from the gods/idols such as Te Agbanlina, Ajahuto and Agasuvi. These were hunters famous for their possession of supernatural power and myth. They were all said to be the descendants of the King of Dahomey (Republic of Benin) who positioned them across the spatial length of the Gulf of Guinea (which Badagry Creek is part of) to protect his territory. The gods also issued policy based on the need to mark an occasion dedicated to a particular day for fishing festivals and sacrifices- another means to exercise control of fishing efforts. Usually, religious ritual is a means of communicating ideas and policy statements in the context of religious practices and adherence. Shultz and Robert (2009) stated that a ritual must fit into four categories. These four categories are that it must be a repetitive social practice, it must be set off from the routines of day to day life, it must follow some sort of ritual schema, and it must be encoded in myth. Ritual often has its roots in myth and religion, tying itself to ancient practices between the divine and humans.

The British colonial master introduced registration of fishing crafts through the use of registered plate number. Issues relating to fisher's registration, conflicts over fishing grounds, and tax payments by fishers were all handled by local High Chiefs. The High Chiefs used blood ties and marriage links in their judgement of whose fish catch or value worth will be used for tax payment or exclusion, or who could or could not fish. The race to fish was moderated by the local chiefs through the use of fishing festivals and commemoration of the gods (such as Ajahuto and Agasuvi).

Open access remained the order at the emergence of self-rule following the independence. The King, De Wheno Aholu Menu-Toyi 1 upon becoming the king abolished tax payment by fishers, stopped the registration of crafts and reduced influence of blood ties and marriage as a means of barrier to entry. This was his attempt to abolish the memory of colonial period and foster free enterprise in the creek. Unfortunately, this singular pronouncement shifted the creek into an open access system; a regime at the heart of fisheries unsustainability. Conflicts over fishing rights, fish theft, incursion to fishing area, setting and utilising unauthorised nets are dealt with by using social institution of family, council of elders (patricentricity), government institutions (judiciary and enforcement agent-police) and spirituality-Zangbeto. Zangbeto as a traditional vigilante institution has survived and maintained its relevance in Badagry as a traditional military – cum-police outfit that defended the people and maintained law and order in the communities and ran parallel to the State's policing.

In the last three decades the State Government has used a management system based on the principle of the use of reward and punishment. The fishers operating in the Badagry were offered largesse/ assistance in terms of grants, loans and subsidies, installment payment for fishing input (nets,outboard engines and facilities for serving engines) from proceeds of catches, and construction of fishing infrastructures such as a jetty at Ajido, among others. Fishers are encouraged to form cooperative societies so as to benefit from the government largesse. There are fisher groups formed on the basis of types of fishing gears, fishing grounds, and mode of fishing. Since the 1990s there is a shift away from the top-down mode of hierarchical governance style. But the first order of governance (in which case, rules of engagment is largely at the level of the national government) has prevailed, as the successive state government still battles with nitty-gritty of governance activity in relations to fisheries. Decrees, laws and edicts have been promulgated by states and federal governments regarding management of inland fisheries: Inland Fisheries Decree 1992 (No. 108 of 1992), Coastal and Inland Shipping (Cabotage) Act (No. 5 of 2003), Sea Fisheries (Fishing) Regulations, 1972 (L.N. No. 99 of 1971), Sea Fisheries Decree 1992 (No. 71 of 1992) and National Inland Waterways Act 1997 (No. 13 of 1997).

2.4. Impacts of sand mining, transportation and tourism on fishing activities in Badagry Creek

In this period of Anthropocene where human activities impact on Common Pool Resources (CPR), the fishers in the Badagry Creek have to cope with the challenges of eking their living alongside other economic pursuits namely: sand mining, transportation and tourism.

2.4.1. Sand mining

Sand mining and dredging is a common operation in coastal communities globally, Badagry Creek inclusive. Piles of mined or dredged sand from activities of sand miners using the local equipment and dredging companies can be seen lining the banks of the creek and its tributaries, most notably at Ajido, Akarakumo, Topo, and Marina among others (Photo 11.1). Although accounts of impact of sand mining or dredging appear to be mixed, fishers operating in the Badagry Creek have claimed that activities of sand miners as a result of equipment used especially at night impact negatively on their fishing productivity. The sound generated from the miners' tools result in fishes moving further offshore.

The miners are also known to destroy fishers' nets and other gears; alleged to mine around and in the fishing grounds and spawning areas. The miners are said to be powerful as they have the support of some unscrupulous state and local governments officials many of which illegally direct and share proceeds of illegal sand mining activities. In the view of the fishers, sand mining activities are sponsored by the well connected individuals and the fishers often lose out in the power play. The evidence for this scenario may be gleaned from the fact that the artisanal miners often boast of their influences in high places. In many cases where there had been conflicts and which are reported to the law enforcement agencies, the miners are left off the hook and fishers are left to lick their wounds as there are no compensations. Anecdotally, the power of the artisan miner is real and they are always eager to rub it in the faces of the fishers. The possibilities of a win-win situation is ruled out with the sand miners and dredgers and fishers. Fishers consider activities of sand miners and water hyacinth as virtually the same menace.

Photo 11.1. Water hyacinth, and mined sand being discharged at Ajido.

There is an ongoing Badagry Port & Free Zone project in which the sponsors are partnering with the Nigerian Government and business leaders to help plan Nigeria's economic future through the port and inland solutions necessary to create strong, sustainable growth. The project aims to address the expected infrastructure challenge by providing shipping lines and supply chain managers with the best productivity, location, flexibility and cost effectiveness to power the global supply chains of Nigeria's leading brands. The state-of-the-art multi-purpose facility will offer its customers superior hinterland connectivity and the deepest

water in West Africa thus creating a sustainable competitive advantage for Nigeria going forward (www.badagry-port.com). The project sponsor also claimed that throughout the project's lifetime, it will support community based projects that can make a difference in a sustainable way without creating dependency – "Wherever we operate, we do our best to accommodate the different cultures, lifestyles, heritage and preferences of our neighbours" (www.badagry-port.com). Fishers are optimistic that at the completion of the Badagry Port & Free Zone project a better proportion of the estuarine will be open leading to an unhindered movement of the fishes inshore and offshore.

2.4.2. Transport

Historically, it was the water way which provided all forms of commerce and trading activities to flourish across the West coast of Africa. In the eighteenth and nineteenth centuries, Badagry played a crucially important role as an Atlantic port. Fishing and transportation co-exist peacefully resembling a win-win scenario. The transporters using the canoe and the out board engine have no known conflict mutually ensuring peaceful coexistence with relationships that are fully enshrined in cooperation (Photo 11.2). In the course of the transporters carrying out their businesses, fishers claim that transporters operating in the night use their headlamps and other devices that lighten their pathways and in the process avoid tampering with nets and traps at the fishing grounds and outright collision with fishing crafts of the fishers. The transporters in some instances help convey information to the families of the fishers back home and also share food and other effects as the need arises. There are no extra efforts such as meetings, since it is an instinctual respect, and evidently there will not be one since they both compete for different spatial: vertical or/and horizontal portion of the creek.

Water transportation is an integral component of the development of Lagos State's inter-modal transport system. The physical environment of Lagos is well-suited to accommodate water transport as about 17% of Lagos is composed of lagoons and waterways. This vast system of inland waterways provides a rich and thus far relatively unexploited means for transporting cargo between port facilities in Lagos State. The State is evolving plan to use the waterways as means to decongest the notorious vehicular traffic.

2.4.3. Eco tourism

The creek is an integral system for the tourism development. Aside from being historically well mentioned in the oral and written literatures on the Atlantic slave trade of the 18th century, on its own Badagry Creek is a delight. Driving from one end to another and watching beaches and banks will convince anybody that its preservation is an environmental asset. Getting to the Point of No Return, every tourist must be ferried to the two ends through the creek.

The Point of No Return is the gateway by which the slave bids goodbye to the land, his families, history and culture and starts the journey to a life of sorrow, pain, inhumanity to man and lowest debasement *Homo sapiens* would ever fall to. Badagry is a place where the history and the story of the slave trade is prominently associated with and where that dark story of human civilization is preserved. There is the famous first storey building in the country (Photo

11.3), the Mobee family museum: which warehouses the relics of the slave trade, the prison yard of slaves (Photo 11.4) and Points of No Return. Streams of tourist visit these sites. Fishers consider the relationship with eco-tourism an inter-sectoral boon which is positive for the fishing community. Tourist are exposed to tasting and buying fishes and fish products.

Photo 11.2. Motorised boats used in ferrying passengers and good across the Badagry Creek.

The efforts of the Lagos State Government, private bodies and indigines are yielding fruits. Resturants, lodges and other facilities which promote eco-tourism are increasingly being promoted by private and corporate bodies. Both local and international tourists could be seen at any point in time visiting different locations mentioned in this study. The Agbalata market established in 1940 (local market) is another important resort as visitors can get fresh fish and fish products as well as other artifacts of interests which can always serve as memorabilia. There is every justification to believe that there is an increase in the activities related to eco-tourism and this has continued to define the landscape and the rapid developments further evidenced across Badagry, which however over time may take away or lose its innocence. There is huge transformation in the outlook of Badagry. Simply put, the more the visitors, the more blessings to the livelihood across the value-chain of the fishers and the fishing communities.

Photo 11.3. Front view of the famous first storey building in Nigeria.

Photo 11.4. Picture of tour guide and visitors at the Mobee slave relics museum in Badagry, Lagos, Nigeria.

3. Discussion and Future Implications

In this paper, 76 species across 47 families were reported based on a review of literature. The difference in the number of species between later studies and earlier work may indicate evidence of decline in fish species diversity. There is an urgent need to conduct studies on spatial and temporal species distribution for the creek so as to generate time series analyses fundamentally required to provide bedrock for scientific information prior to developing a management plan for the creek. The apparent hierarchical governance regime in place has proven unsustainable, hence there appears a need to consider moving towards a co-management governance regime whereby all stakeholders: fishers, the State Government, academics, civil society and others work mutually to formulate rules and regulations and to ensure compliance.

Also, there is the need to conduct scientific and social study on the impact of sand mining on fishing activities. It is needed that the State Government prohibits sand miners from operating around areas fishers identified as fishing grounds and spawning areas. Information from this effort should form the basis for inter-sectoral governance scheme for the creek and should be used by the State in formulating policy guidelines for the operations of the artisanal miners. Transportation and eco-tourism have both positive impacts on the fisheries of the creek so far. This relationship should be used in promoting sustainable development in actualising the master plan for the city of Badagry.

4. Conclusion

This study affirmed the status of the Badagry Creek as an abundantly rich estuarine system. It also highlighted its historical relevance to the people of the coastal community recalling the impact the creek played in the settlement and the economic and social makeup of the fishing communities. It reported a transition wherein strong family affiliation through the institution of intermarriages played a significance role in the fisheries governance structure to the present situation wherein the basis for association among fishers is fishing interests. We described the present relationship between the State and fishing communities as being less than amicable and lacking trust, and therefore recommended a shift towards a co-governance management arrangement. The fishing communities enjoy a win-win relationship with the transportation and eco-tourism sub-sectors. An antagonistic relationship, however, exists between fishers and sand miners in the creek.

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CHAPTER 12

Capture Fishery of Koshi Tappu of Saptakoshi River, Nepal: Way Forward for Sustainable Management

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Abstract The objective of this paper is to elucidate an overview of the inland fishery of Koshi Tappu area of Saptakoshi (Sapta means seven) River. The Saptakoshi is the largest river of Nepal comprised of seven large tributaries, namely Tamakoshi, Arunkoshi, Dudhkoshi, Tamurkoshi, Bhotekoshi, Sunkoshi and Indrawati. All of these tributaries flow down from high Himalaya down to southern plains. Therefore, due to large coverage, the Saptakoshi known to be endowed with more than 200 fish species but a recent compilation has shown 134 native and 7 exotic fishes. It is likely that more fish species could be recorded with further investigations. The Saptakoshi after entering into the southern plain spreads wide forming the Koshi Tappu over an area of about 175 km^2 (68 sq mi.) in the plains of eastern Nepal occupied by rivers, oxbow lakes, permanent ditches, ponds, water logged areas, farmland, forests, villages etc. Preliminary estimates showed that capture fishery is likely to comprise of predominantly 10 major fin fish species in addition to others with minor contribution, edible snails, bivalve, shrimp, *makhana* (*Euryale ferox*) and water chest nut (*Trapa* spp). The annual fish yield in Koshi Tappu is yet to be estimated. The per capita fish yield was as low as about 1-2 kg per fisher per day probably attributable to strict licensing system and provision of fish catching only by the use of cast net and women fishers' handmade 'covering net' known as *tappi jal* or *chauki jal*. Use of drag net, gill net, hook and line are prohibited. The fishers often use wooden boats for fishing activities. Recently, it was reported that the fishery in the area is under overfishing pressure. However, that might be the case outside the reserve area, because it is unlikely that fishing by the sole use of cast net and *tappi jal* would cause overfishing in such a vast area. Therefore, we conclude that fishery in Koshi Tappu should be reexamined considering the *win - win* strategy of conservation of wild animals and fishing livelihoods, minimizing conflict in park management and benefiting fishers living in the park and visitors. If indeed the fishery is declining, the reasons of the rapid depletion of fish stock should be analyzed to develop sound management strategies for sustainability given the added stressors of climate change and anthropogenic activities.

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1. Introduction

In Nepal, the captured fisheries contribute ~0.4% of the total GDP employing thousands of fishers for livelihood with majority composed of women. The estimated total captured fish yield is 21,500 mt per year with a productivity of 18 kg/ha (CBS 2014). Nepal has three main river basins and a Mahakali River system. All these rivers flow down from the upper Himalaya towards the southern plain, ultimately draining into the Ganges River. The total length of the Saptakoshi River (hereafter 'Koshi') is 720 km. The water flow, ecology and fish biodiversity of the Koshi River has been known to be impacted by erratic rainfall, temperature rise, melting snow, glaciers burst, splash flood, deforestation, hydropower dams, use of water for agriculture and fisheries exploitations (Gurung et al. 2016). Moreover, it is likely that fish stock in the area has also been impacted by pesticides use in agriculture field, sand removal from river-beds and many other anthropogenic activities.

Recently fishing in Koshi River has been elucidated to be conflicting with birds and freshwater dolphin conservation activities (Paudel et al. 2016). Conflict between local people and park is a major conservation issue that is difficult to resolve (Limbu and Karki 2003). The local people may not favor the conservation activities because they cannot realize its long term importance, instead being driven by immediate needs for their livelihood (Bennett and Dearden 2014). All these dimensions are likely to create a negative impact on fisheries and depending communities in ensuring livelihood, food and nutritional security. The fishing based livelihood is one of the oldest systems in Nepal, as there are several ethnic communities adapted to occupy full time profession in fishing and other water-related activities (Gurung 2003, 2014). Such ethnic communities who are dependent on wetlands represent about 18% of the total population of the country (IUCN 2004). These communities recognize and harness social and traditional values associated with fishing in natural common waters, given the importance of fish and other aquatic products in human dietary system, religion and culture in the Nepalese society.

Fisheries have traditionally played an important role in the livelihood of dependent communities (Buckston et al. 2009; Thapa and Dahal 2009), as some communities have lived inside the park for centuries (Paudel et al. 2016). Other than fish, freshwater gastropods, bivalve and other invertebrates have been described for ethno medicinal use (Prabhakar and Roy 2009). The uses of such organisms are also known to be common in the Koshi Tappu area. However, further investigation is desirable to estimate the value of those natural products for livelihood, human nutrition and food perspectives. The main season of chest nut and makhana or fox nut (*Euryale ferox*) harvest is April to May. The fox nut is harvested mostly by female and children rather than by adult male.

Conventionally, sustainable fishery can be defined as harvesting of fish in a sustainable manner, where the fish population does not decline over time due to fishing practices (i.e., fishing removes old and bigger sized stock to provide recruitment opportunity to the newer, Krebs 2007). Mostly, overfishing has been considered major causes of fisheries depletion and collapse; however the global fish stocks depletion cannot be simply attributed to fishing alone (Hauge et al. 2009). Instead, other anthropogenic activities causing habitat destruction, pollution and climate change play a substantial role on fish depletion (Gurung 2013) as well

as natural factors such as preying of fish by aquatic mammals such as Dolphin in Koshi River (Paudel et al. 2016).

Past studies have shown that uncontrolled fish harvesting can severely deplete fishery resources depriving local fishers from their major source of subsistence (Dugan et al. 2010; Thapa and Dahal 2009). To cope with such a trend, advocacies to protect natural resources has been initiated and supported by the universal sustainable development goal's (USDG) agendas. To achieve some of these objectives, the present paper provides insights on ways to reduce threats to biodiversity and enhance ecosystem productivity through improved governance, planning and management.

2. Materials and Methods

2.1 Study area

The Koshi Tappu Wildlife Reserve is situated at the altitude of 75 to 81 m (246 to 266 ft). It is a protected area established in 1976 and designated as a Ramsar site in December 1987 covering 175 km^2 (68 sq mi) area in the Sunsari, Saptari and Udayapur Districts, Nepal (Fig. 12.1). The flood plain is comprised of grass marshlands, oxbow and swampy lakes, sand fields, gravels, boulders agricultural lands, where more than 93,323 people from 16,280 households are known to live in year 2009 (Khatri et al. 2012; Oza 2014).

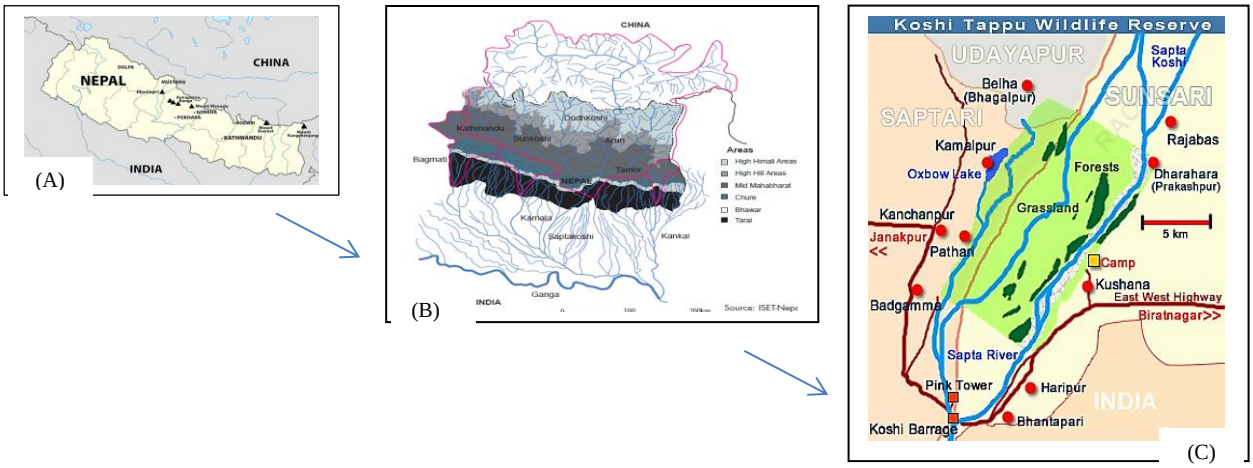

Figure 12.1. Study area: (A) map of Nepal, (B) catchment area of Koshi, and (C) map of Koshi Tappu.

The information on the fish catch, yield, and ethnic communities were collected from secondary sources. To complement this, a pre-structured questionnaire based survey was conducted focusing on socio-economic elements such as the total number of fisher, ethnic communities of the area, fish catch, fishing methods and licensing system in addition to details on specific resources such as yield of water chest nut, *makhan*, shrimp, gastropod, bivalve, crab and turtles.

3. Fish, Fisheries, Ethnic Communities, Livelihood, and Conservation Activities in Koshi Tappu

Fisheries activities in Koshi Tappu might represent one of the oldest in Nepal. It is also likely that Koshi Tappu represents an area with the highest number of fish species aggregation in per unit area in Nepal because of the uniqueness of ecology formed by both the cold and warm climates well as land composition of the flood plain.

Subsequently, the Koshi River system probably represents the largest capture fisheries in Nepal, in terms of yield volume, fish species abundance and the number of fishers dependent for livelihood (Paudel et al. 2016; Gurung et al. 2016). Thapa (2008) reported 92 fish species from the Koshi River; 81 species were enlisted by Limbu and Subba (2011). Gurung et al. (2016) has shown compilation of 135 native fish species and 7 exotic species. It is proclaimed that 200 fish species may occur in the Koshi River indicating that more detail studies are required to obtain a holistic inventory. It is likely that there are new species yet to be discovered (Edds and Ng 2007) from Tamakoshi, Likhu, Bhotekoshi, Dudhkoshi, Arun, Indrawati and theirs hundreds of small and big tributaries. A study conducted by WWF (2015) has added several new species. Edds and Ng (2007) have also added seven fishes from eastern Nepal.

The dominant fish in capture fishery in Koshi Tappu are *Clarias batrachus*, *Heteropneustis fossilis*, *Wallago attu*, *Channa striatus*, *Channa punctatus*, Jalkappor (*Clupisoma garua*), Kanti (*Mystus seenghala*), Bhunna (*Notopterus notopterus, Notopterus chitala*), Mahseer (*Tor putitora)*, freshwater eel *(Mastacembelus armatus*), Gainchi *(Macrognathus aculeatus*), Kotri *(Puntius* spp), Tengra *(Mystus cavacius*), Rewa *(Chagunius chagunio*), Rohu *(Labeo rohita*) and *Bagarius* spp (Figure 12.2). Except few, the composition of captured fish suggests that most fishing was probably carried on wetlands, oxbow lakes, ponds and banks of the river using the cast net and *tappi net* but not the mainstreams and deeper pools of the river.

Buckton et al. (2009) mentioned that fish from the wetlands in Koshi Tappu ranked the first among other collected or gathered food for consumptive and non-consumptive use, implying that fish is one of the most important source for food, income and livelihood. Many other studies reaffirmed that fisher's families were able to purchase rice and other foods after selling the fish caught from wetlands (Buckton et al. 2009; Thapa and Dahal 2009). The same study has rated fishing as the main occupation in terms of values provided by the wetlands in all areas of the Koshi Tappu Wildlife Reserve. Since the population living inside the Reserve is about 93,323; it can thus be estimated, if 10% of the total people are involved in fishing with 1 kg per day catch, then in a year the yield estimate reaches 3,406 metric tons. However, a true amount of fish capture per annum from the Koshi Tappu and the Koshi River system has yet to be estimated realistically. The main large market for selling fish is in Inuruwa and small markets are located at Laukahi and Sunsari. The captured fishes from the rivers are transported to the market usually on bicycles. Most fishermen prefer to sell the fish directly to consumers.

Our survey showed that mainly four to five ethnic communities were actively engaged in fishing and food fish gathering activities. Although there are several ethnic communities in hills and mountains associated with traditional fishing occupation, in Koshi Tappu *Mushhar,*

Bardar, Sardar, Jhangad, Muslim, Batarr, Mukhiya, Malaha, Sahani and *Urau* were specifically engaged in fishing as full- or part-time fishers for their livelihood. Paudel et al. (2016) mentioned involvement of 15 ethnic communities in fishing in Koshi Tappu area. Although there are no barriers for any other ethnic communities to enter fishing, usually the landless, poor and marginalized communities actively engage in fishing whether from the hill, mountain or plain. The main season for high fish catch was surveyed to be in October and November. March and April were the slack season. Women fishers locally use a gear called *tappi jal* or *chauki jal* for capturing fish for their household consumption. Besides such old and primitive trends, fishing for sports, recreation and tourism are also evolving slowly by amateurs and professionals in Nepal.

4. Conservation Management and Fishing Conflict in Koshi Tappu

The major objective of the Koshi Tappu Wildlife Reserve is to protect biodiversity of the area. As a result, the use of gill net, drag net, hook and line, chemicals and other unconventional methods of fishing are prohibited. However, fishing by the use of cast net and *tappi jal* are allowed to local fishers living inside the park for their livelihood options. For any fishing activities, one requires to obtain the license from the park administration. Paudel et al. (2016) mentioned the use of gill nets in Koshi River, but our study revealed that the use of gill net inside the park was banned. The existing fishing by using cast net and *tappi jal* implies that the fishers can mostly collect fish from being close to the bank of the river, oxbows, small wetlands, ditches and shallow waters. The large deeper pools and areas with rapid flows of the vast river have been remained inaccessible implying that the great potential of the rivers and fish stocks is likely untouched, protected and underutilized. However, estimation of fish stock in water bodies is difficult unless modern and sophisticated methods are used (Welcomme 1983).

There are insufficient studies related to fish and fisheries of Koshi Tappu floodplains. One of the reasons could be the conflict of fishing activities with bird, dolphin and other conservation programs (Timsina and Ranjitkar 2014, Bhattarai 2015, Paudel et al. 2016). The conflicting situation in national parks among management, animals, farmers and fishers is common (Limbu and Karki 2003, Shrestha et al. 2006), probably due to high population density inside the park among others (Timsina and Ranjitkar 2014). Some ethnic communities were living there over more than 100 years (Paudel et al. 2016). Most people inside the parks are poor with low income and insecure living conditions. About 87% of people were involved in agriculture, but only 20% had food security (Timisna and Ranjitkar 2014). In such socio-economic conditions, the conflict and entrust (Bennett and Deardon 2014) become more inevitable due to scanty resource and opportunities. To mitigate the conflict, opportunities of livelihood to people without harming the targeted plants, animal, ecology and environment would be advantageous. Recently, the strategies for ending overfishing, but catching more fish has been proposed (Zhou et al. 2015). To plan any such intervention, primary data and information related to the number of fishers, annual fish catch, fish composition, contribution to livelihood, gear and crafts used, value chain, ethnic communities, conflict

with wildlife park management, inventory on fish species, flora and fauna, licensing system, transportation and market destination would be desirable.

One of the possible interventions for obtaining higher benefit in terms of biodiversity conservation and livelihood enhancement to communities is developing fishing tourism (Gurung and Thing 2016) in harmony with the Wildlife Reserve policies and regulations. The '*guru mantra*' of such strategic plan is to reduce fishing efforts as much as possible while bringing a higher positive impact on fisher's livelihood. It is said that a 2kg fish caught by local fisher might fetch only little income. Contrarily, if caught by tourist anglers then the price might indicate a much bigger payoff because the tourist is likely to spend on travel, transport, leisure, food, outfit clothing, beverages, guide, porters, recreation, fishing tools, equipment, baits and so on, thus benefiting all steps of the value chain (Gurung and Thing 2016). Therefore, by involving fishers in jobs other than fishing may reduce fishing efforts also in a way that fishes are likely to be conserved. Since, fishing is a regular activity (Photo 12.1, 12.2, 12.3, 12.4), thus, the activities might need to be regulated with the support of government, non-government agencies and local fisher's communities. People from fishing community could be offered jobs as a guide utilizing fishing related skills and services, or become involved in transport, food catering, home stay and others because the primary concern of the fishers is livelihood and income for family rather than the activity of fishing *per se*.

Photo 12.1. *Labeo rohita* (Rohu) captured in Koshi Tappu.

Recently it has shown that in many tourism activities the involvement of community at tour destinations are negligible, thus threatening the sustainability of such programs (Samarth 2014). Instead, urban elite operators are receiving the highest benefit out of the tour business. It has been argued the involvement of communities at destination is highly important for realizing sustainable tourism development. Ignoring poor stakeholders at destinations might cause conflicts (Bennett and Dearden 2014). Thus, Samarth (2014) has identified three key intervention areas for sustainable tourism: product development, marketing and the regulatory environment. If these arguments are correct, then interventions into fishing tourism must be initiated by involving fishers into service-related

activities for employment to enhance product development as an alternative to fishing, so tourists can experience high value fishing activities. The promotion of fishers into the value chain activities has been illustrated as one of the key fish conservation approaches (Gurung and Thing 2016).

The Koshi Tappu is one of the most attractive tourism places. There could be possibilities for developing lucrative angling based tourism in the area because the fish species (Gurung et al. in press) seem to be highly compatible and suitable to foster sport fishing. For example, mahseer (*Tor* spp.) is a world class sport fish having excellent tackling characteristics (McDonald 1944). Besides mahseer, minnows, *Channa*, catfishes and several other fishes form highly desirable fishing options for the Koshi Tappu.

Photo 12.2. Fried fish ready for serving on roadside restaurants, Nepal.

The fishing tourism is a multibillion dollar activity worldwide (Lemelina et al. 2012). It thus has immense potentiality to generate income for the enhanced livelihood of poor fishers along with protecting the fishes of the Koshi Tappu from being overfished (Gurung and Thing 2016). This approach is likely to be effective for protecting dolphin species as well as for averting potential danger posed by gill nets to them. This would also help maintain desirable fish abundance for Dolphin in the river. Because fishing by tourist will be an amateur activity, it will likely help conserve the fish population as most of the fishing would be of 'catch and release' type.

It seems that though there are allegations of overfishing in Koshi Tappu, but considering the strict licensing system, use of nets, crafts and fish captured by local fishers the fishery potential has been lowly undermined and under fished instead. Since the river flow in Koshi is reported to be dangerously increased hundreds-folds due to flooding in monsoon seasons (June-September), many of the conserved fish are likely to be flown down in flood, yielding no benefit to local people by conservation. In such circumstances, it is likely that the fishes in river should be fished before they are swept away by flood by allowing permissible fishing activities in the main river course.

Photo 12.3. Fishing by cast net.

Photo 12.4. Fisher women and kids involved in fishing activities in Koshi Tappu.

5. Way Forward for Sustainable Fisheries Management in Koshi Tappu

The Universal Sustainable Development Goals (USDG) has prioritized sustainable management of forests to combat desertification and halt biodiversity loss among others (Osborn et al. 2015). Working in line with the agenda, however, there have been only preliminary studies on fish and fisheries to realize sustainable management of fishery resources in Koshi Tappu. Therefore, detailed work on developing strategies for sustainable capture fisheries should be conducted for sustainable management of Koshi Tappu fisheries. The Koshi is one of the trans-boundary rivers. Therefore, for conservation of rare, endangered fishes, a multilateral team could be envisaged. Since the river is endowed with aquatic biodiversity of global value supporting the livelihoods of millions, research and management activities on fisheries is inevitable.

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